SCIENCE AND ENGINEERING EDUCATION AND MANPOWER

HEARING

BEFORE THE

SUBCOMMITTEE ON
SCIENCE, RESEARCH AND TECHNOLOGY

OF THE

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U.S. HOUSE OF REPRESENTATIVES

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[1] On assignment to Budget Committee for 97th Congress.

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SCIENCE AND ENGINEERING EDUCATION AND MANPOWER

THURSDAY, FEBRUARY 11, 1982

House of Representatives,
Committee on Science and Technology,
Subcommittee on Science, Research, and Technology,
Washington, D.C.

The subcommittee met, pursuant to call, at 10:20 a.m. in the Moot Courtroom, University of Pittsburgh Law School, Pittsburgh, Pa., Hon. Doug Walgren (chairman of the subcommittee) presiding.

Mr. **Walgren**. Let me call us to order and apologize for being so late.

We certainly do appreciate the opportunity to bring the subcommittee to Pittsburgh, and I would like to recognize the chancellor of the University of Pittsburgh, Dr. Wesley Posvar.

Dr. Posvar, we appreciate being here.

Dr. **Posvar**. Mr. Walgren, I want to say on behalf of the University of Pittsburgh that we are honored, indeed, to host the Subcommittee on Science, Research, and Technology.

We welcome you to your home city of Pittsburgh and, of course, all your colleagues from other parts of the country are most welcome also.

I also want to express welcome to members of the academic and industrial community who are here to testify. I think you are going to have before you a very strong case that we are definitely opening a partnership not only as a government but between higher education and American industry.

So with that, I hope you have a very pleasant day.

Mr. **Walgren**. Thank you very much, Dr. Posvar.

It is a great honor personally to bring the subcommittee to the University of Pittsburgh and the Pittsburgh area. We all thank the university, and particularly the many other people involved in it, for being our host.

This morning the subcommittee is focusing on the impact of reductions in Federal programs supporting science and engineering education on universities and on industry in the Pittsburgh area. We have three panels of witnesses from various levels of industry and universities.

The scientific state of our country, I am afraid, could be characterized as dismal. It is certainly cause for great concern for everyone who is interested in the future of our society.

The proposed Reagan budget cuts, I am afraid, in science, particularly in science education, are only going to make matters worse. Just this week in Indiana the President said, "There were no budget cuts; only the rate of increase in the budget was cut." Well, that is not quite the truth when you look at individual programs.

My people in the public will take that to mean that we need not be too concerned; that the Government and the efforts that we have come to expect from Government will remain relatively intact. I am afraid that nothing could be farther from the truth.

This subcommittee has jurisdiction over the National Science Foundation. Last year the Reagan administration cut the budget requests for the Foundation's science and engineering education programs from $112 million to $10 million. Congress intervened and was able, through its process, to restore the science education function to a level of about $27 million.

The difficulty is that if we drop our effort in this area from the $100 million range, and last year the pressure of the administration went to the $20 million range, and this year down to $10 million, you can see that our effort as a society is going to diminish. If that is not an actual budget cut, I am afraid I certainly don't know what one is.

The budget cuts in the science and engineering education programs truly widen the science and technology gap between America and the rest of the world. When you compare the United States to the Soviet Union, you will see that we are training our people at a far less rate and graduating far fewer engineers and scientists at every level of our educational system.

Only one-sixth of our high school students take a junior or senior high school level science course. Only one-half take a math course after the 10th grade. Only 15 percent of all high school students take chemistry. Only 7 percent take any physics. Two-thirds of all American high schools require only 1 year of science or math for a high school diploma.

In Japan, all college-bound high school students take 4 years of math and 3 years of science.

In the Soviet Union, all high school students take 5 years of physics and 4 years of chemistry. The Soviet universities graduate twice as many scientists and five times as many engineers as American universities.

On January 20, at the President's press conference, he said that we needed more people that were trained in engineering. Responding to questions dealing with education he cited the need for people to be able to move from unskilled jobs into the jobs of the future, those involving engineering. He pledged his administration would "do everything it could to provide help in that area."

I am afraid the February 8 budget provides absolutely no support in science and engineering education. The budget cuts in that area threaten our very ability to train skilled scientists and pose a real threat to our future ability to compete technologically with the rest of the world.

A country that is not scientifically sound cannot depend on being militarily secure no matter how many billions we spend on expensive weapons and aircrafts. Every veteran knows that without skilled manpower to design, manufacture, repair, and operate them, they are worthless.

Last year Congress provided about $21 million for the National Science Foundation education programs. I hope that we can at least bring back that level of support this year.

Our subcommittee is interested in science and engineering education from two viewpoints.

First, we want to revive innovation and productivity in our economy. We have held four hearings on innovation and productivity, and it is clear that without a skilled, technically trained work force we will not have a healthy economy with any innovation in it. But we have no national policy regarding scientific and engineering manpower programs, and we suffer because of it.

Second, every citizen in general needs to be scientifically aware. We live in a technological world where understanding of technical excellence is necessary for understanding our citizens' role in today's economy. We struggle with imports from Japan and we need to know, as citizens, what supports in our own economy must be put together in order to match that kind of competition.

To take a first step on this problem, a number of us on this committee, including myself and the chairman of the full committee, Don Fuqua, have introduced a bill entitled "the National Engineering and Science Manpower Act of 1982."

This bill would establish a fund to develop U.S. technical engineering and scientific manpower resources. Money would be spent on these educational efforts on a 1-to-1 matching basis with money provided by private industry. It recognizes that our needs in this area are so great that the Government alone is not going to be able to be the only funding source.

But the truth of the matter is that industry is intensely interested in developing this capacity. These are the new engineers of the future, the new individuals that will be provided with success for American business in the future, and industry should be, and every side is willing to join in a joint effort in this area.

The money that we would pool under this bill would be available for fellowships and instructional equipment. Instructional equipment is a major crisis because our schools cannot keep up with the expense of leaps forward the modern equipment is making these days. This money will be available for instructional equipment, salaries, teachers, or other costs related to solving our manpower problem.

We are looking, we hope, for funding in the range of $50 million for this fund in the first year of operation.

We have a very good and balanced group of witnesses this morning from industry and from universities. I certainly appreciate them giving their time to put together presentations which we, as Members of Congress from across the country, can take to Washington which will have an effect and an impact on the positions that the Committee on Science and Technology takes with respect to this area in this extremely difficult budget year.

So I want to welcome them and express my appreciation for their time and testimony.

[The opening statement of Mr. Walgren follows:]

OPENING REMARKS

CONGRESSMAN DOUG WALGREN

CHAIRMAN, SCIENCE, RESEARCH

AND TECHNOLOGY SUBCOMMITTEE

FIELD HEARING IN PITTSBURGH, PENNSYLVANIA

FEBRUARY 11, 1982

MY COLLEAGUES ON THE SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY AND I ARE DELIGHTED TO BE HERE AT THE UNIVERSITY OF PITTSBURGH THIS MORNING. I WANT TO THANK CHANCELLOR POSVAR AND MANY OTHER PITT PEOPLE FOR HOSTING THIS HEARING. THEY HAVE MADE US FEEL VERY WELCOME.

THIS MORNING THE SUBCOMMITTEE IS FOCUSING ON THE IMPACT OF REDUCTIONS IN FEDERAL PROGRAMS SUPPORTING SCIENCE AND ENGINEERING EDUCATION ON UNIVERSITIES AND INDUSTRY IN THE PITTSBURGH AREA. WE WILL HAVE THREE PANELS OF WITNESSES FROM THOSE GROUPS.

THE SCIENTIFIC STATE OF OUR COUNTRY IS DISMAL. AND THE PROPOSED REAGAN BUDGET CUTS WILL ONLY MAKE MATTERS WORSE. THIS WEEK IN INDIANA, PRESIDENT REAGAN SAID, "THERE WERE NO BUDGET CUTS, ONLY THE RATE OF INCREASE IN THE BUDGET WAS CUT."

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MANY IN THE PUBLIC WOULD TAKE THAT TO MEAN THAT NONE OF OUR CURRENT GOVERNMENT EFFORTS ARE BEING HURT. NOTHING COULD BE FURTHER FROM THE TRUTH.

THIS SUBCOMMITTEE HAS JURISDICTION OVER THE NATIONAL SCIENCE FOUNDATION. LAST YEAR THE REAGAN ADMINISTRATION CUT THE BUDGET REQUEST FOR THE FOUNDATION'S SCIENCE AND ENGINEERING EDUCATION PROGRAMS FROM $112 MILLION TO $10 MILLION. THIS YEAR THE ADMINISTRATION PLANS TO ELIMINATE ALL THE FOUNDATION'S EDUCATION PROGRAMS EXCEPT GRADUATE FELLOWSHIPS. IF THAT'S NOT AN ACTUAL BUDGET CUT, I DON'T KNOW WHAT IS.

THE BUDGET CUTS IN SCIENCE AND ENGINEERING EDUCATION PROGRAMS THREATEN TO WIDEN THE SCIENCE AND TECHNOLOGY GAP BETWEEN AMERICA AND THE REST OF THE WORLD.

COMPARED TO THE SOVIET UNION OR OTHER WESTERN NATIONS, WE ARE SCIENTIFICALLY ILLITERATE.

ONLY ONE-SIXTH OF OUR HIGH SCHOOL STUDENTS TAKE A JUNIOR OR SENIOR LEVEL SCIENCE COURSE. ONLY ONE-HALF OF OUR STUDENTS TAKE A MATH COURSE AFTER GRADE 10. JUST 15 PERCENT OF ALL HIGH SCHOOL STUDENTS TAKE CHEMISTRY, AND ONLY 7 PERCENT TAKE PHYSICS.

Two-thirds of all American high schools require only one year of science and math for a high school diploma. In Japan all college-bound high school students take four years of math and three years of science. In the Soviet Union, all high school students take five years of physics and four years of chemistry.

The Soviets graduate twice as many scientists and five times as many engineers as American universities.

On January 20 at a press conference, President Reagan said that we need more people trained to qualify for skilled jobs. He pledged his Administration would do everything it could to provide that training.

His February 8th budget report gives the lie to that pledge. The science and engineering education budget cuts threaten America's ability to train skilled scientists and pose a real threat to our future ability to compete technologically with the rest of the world.

A country that is not scientifically sound cannot defend itself militarily. No matter how many billions we spend on expensive weapons and aircraft, every veteran knows equipment is worthless without the skilled manpower to design, repair, or operate it.

LAST YEAR CONGRESS PROVIDED $21 MILLION FOR NATIONAL SCIENCE FOUNDATION SCIENCE EDUCATION PROGRAMS AND I EXPECT WE WILL NOT AGREE TO THEIR ELIMINATION THIS YEAR.

OUR SUBCOMMITTEE IS INTERESTED IN SCIENCE AND ENGINEERING EDUCATION FROM TWO VIEWPOINTS. FIRST, WE WANT TO REVIVE INNOVATION AND PRODUCTIVITY IN THE COUNTRY'S ECONOMY. WE HAVE HELD SOME 40 SESSIONS OF HEARINGS OVER THE LAST THREE YEARS ON INNOVATION AND PRODUCTIVITY ISSUES. IT IS CLEAR THAT WE NEED A SKILLED, TECHNICALLY TRAINED WORKFORCE TO HAVE A HEALTHY ECONOMY. BUT WE HAVE NO NATIONAL POLICY REGARDING SCIENTIFIC AND ENGINEERING MANPOWER AND THE MANPOWER PROGRAMS WE DO HAVE ARE UNCOORDINATED. SO OUR FIRST CONCERN IS WITH TECHNICAL MANPOWER FOR THE NATIONAL ECONOMY.

SECOND, EVERY CITIZEN NEEDS TO BE LITERATE IN SCIENCE AND TECHNOLOGY. WE LIVE IN A TECHNOLOGICAL WORLD. AN UNDERSTANDING OF TECHNOLOGY IS ESSENTIAL FOR AN UNDERSTANDING A PERSON'S OWN LIFE.

IN ORDER TO DO SOMETHING TO SOLVE OUR MANPOWER PROBLEMS, I HAVE INTRODUCED A BILL IN CONGRESS, TOGETHER WITH DON FUQUA, THE CHAIRMAN OF THE SCIENCE AND TECHNOLOGY COMMITTEE. OUR BILL

IS THE "NATIONAL ENGINEERING AND SCIENCE MANPOWER ACT OF 1982", H.R. 5254. THE BILL WOULD ESTABLISH A FUND TO DEVELOP UNITED STATES TECHNICAL, ENGINEERING, AND SCIENTIFIC MANPOWER RESOURCES. MONEY WOULD BE SPENT FROM THE FUND ON A ONE-TO-ONE MATCHING BASIS WITH OTHER MONEY PROVIDED BY PRIVATE INDUSTRY. THE MONEY WOULD BE AVAILABLE FOR FELLOWSHIPS, OR INSTRUCTIONAL EQUIPMENT, OR SALARIES OF TEACHERS, OR OTHER COSTS OF SOLVING OUR MANPOWER PROBLEM. THE BILL WOULD PROVIDE $50 MILLION FOR THE FUND IN ITS FIRST YEAR OF OPERATION.

WE HAVE A SUPERBLY QUALIFIED GROUP OF WITNESSES TO DISCUSS ALL THESE ISSUES AND GIVE US THEIR OPINIONS ABOUT THE MANPOWER BILL. I AM LOOKING FORWARD TO THEIR TESTIMONY THIS MORNING.

Mr. WALGREN. At this point I would like to just introduce the other members of the subcommittee who are here with me today: Congressman Shamansky from Ohio and Congressman Al Ertel from Harrisburg, Pa.

Can I invite any opening remarks on the part of either of you?

Mr. ERTEL. Thank you, Congressman Walgren.

I want to thank you for having these very important hearings. They are a means of pointing out some of the inadequacies of where we are going in this country as far as budgets are concerned. I think it is very important that we put the emphasis back on science education and science manpower in this country.

I remember recently when the President held up the want ads and said that we had employment opportunities in the United States, 20 pages of them. I think if he would have examined those ads it would have indicated that most of those want ads were for scientific personnel, personnel who were well trained and well educated.

What we are doing here today is trying to see if we are going to have people who are well trained and well educated for those future ads like that, and whether or not we can supply that pool of people who can bring this Nation along in the world of tomorrow.

I am very much concerned that with our education cutbacks in both science and other areas we will create a generation where we will not have the ability to fill the needs of industry and fill the needs of university faculties for the future.

I think these hearings are an important start in looking at those issues and trying to determine whether or not America will move into the next century with people qualified and equipped to handle the new technological and innovative areas that we must handle.

So I commend you, Congressman Walgren, for having these hearings. I think they are very important. It is also very important that the dialog begin on this issue, and it is appropriate that it begin here in Pennsylvania because of the fact that Pennsylvania has some of the greatest educational institutions in the world.

I appreciate being here with you. Thank you very much.

Mr. **Walgren**. Thank you very much.

Congressman Shamansky?

Mr. **Shamansky**. Thank you, Mr. Chairman.

You have identified me as being from Columbus. I am especially interested in your bill because in my community we have institutions such as the Ohio State University and the Chemical Labs Division of the American Chemical Society.

Science education is vital to our community and it is vital, I think, to the country and, therefore, to the whole Western world.

I do not make any secret of the fact that I believe that this administration, with respect to science education, is not just shooting the country in the foot, but cutting it off at the knees. It is incomprehensible.

I was in China in 1978 and talked to the people who worked for the Chinese Academy of Science. I think we are reaching the equivalent of the Chinese cultural revolution in which we are going to close down education in terms of science and engineering. I fear that while this may not be deliberate, it is a mindless exercise, so far, on the part of the administration. By cutting off the income and telling us that certain areas are off-bounds, all you can do is cut where you can and it makes no difference to them what the consequences are.

I feel your legislation offers us a chance to get out of that box because, clearly, the administration has no concept of what it is doing, especially when they are announcing that they want to abolish guaranteed student loans for graduate students. It is an interesting concept, one which appalls me.

I am very much interested in the testimony of the scholars we have here, especially as my nephew is enrolled in Carnegie-Mellon in electrical engineering. I am very interested in hearing the testimony.

Thank you.

Mr. **Walgren**. Thank you very much.

At this point I would like to again recognize the chancellor of the University of Pittsburgh, Dr. Posvar.

STATEMENT OF DR. WESLEY W. POSVAR, CHANCELLOR, UNIVERISTY OF PITTSBURGH

Dr. **Posvar**. Thank you very much, Mr. Chairman.

I am delighted to have this opportunity to open this testimony. I am going to speak very briefly from the standpoint of an overview, and I am especially pleased because I have testified before this group before in Washington and it is very gratifying to be able to testify before you in my home city.

This room is a moot court—ironically, because what we have to say this morning, my colleagues and I, is utterly relevant and important, just the opposite of being moot.

I would like to speak from an overall national standpoint because I have that perspective in a couple of outside activities. I have been chairman for the last 2 years of the Business-Higher Education Forum, an association of about 30 corporate chief executives and about 30 university and college presidents in which we are forming a common alliance to deal with the kind of problems we are concerned with here this morning.

I am also a member of a committee of university presidents and cooperation directors of industrial research, a committee of about 8 or 10 that is concerned with developing an alliance between university laboratories and industrial laboratories to deal with the problems facing research in the United States.

But in our whole agenda of common concerns, one that I think is vital is potential shortages of manpower and needs for research scientists and engineers, a point that this committee is discussing today and about which its expert members are already extremely well-informed. I really see no point in preaching the gospel to people who know it at least as well as I do or anyone else, because the members of this committee are, indeed, well-informed experts.

Suffice it to reemphasize that we are deeply worried about our ability to train scientists for the future at the national level and, of course, at the level of universities and corporations in the city of Pittsburgh and elsewhere.

In economic terms, in terms of economic analysis, what we are really talking about is capital, and human capital is the most important variety. Investment of capital in this country can be looked upon as a generic need. In terms of real net additon to plant and equipment, investment is now less than 2 percent of the gross national product, which is abysmally lower than the rest of the free world. The growth of GNP per worker in this country is now zero, and yet capital formation is critical to everything else. It is the engine that drives productivity and curbs inflation, corrects the balance of payments, and that could rectify or diminish any and all of our economic troubles.

Basic to all capital is human capital, and that is embodied in the output of higher education. Human capital—managers, engineers, scientists—must be developed before the physical capital—factories, laboratories, and technical services—can reach meaningful levels. So I am concerned that cuts in Federal support of higher education will tend to decrease our output of human capital.

About the subject of research itself, we are deeply worried. There has been in the last 3 or 4 years some modestly encouraging news about research and development. In real terms the Nation's research and development spending as a whole rose slightly, and the percentage of R. & D. applied to basic research has gone up somewhat to 13.6 percent.

But the overall picture is very grim. We have a tremendous amount of catching up to do. I think you are all familiar with these figures, but I will repeat them briefly for the record.

In the last 14 years, since 1968, basic research as a fraction of GNP went down 16 percent. As for all of R. & D. throughout the United States in this period, it was down 19 percent as a fraction of the GNP. In the same period, R. & D. was up 19 percent in Japan, up 14 percent in the Soviet Union, and up 16 percent in West Germany.

The number of scientists and engineers engaged in R. & D. as a fraction of the labor force—and this, of course, stems directly from educational opportunities—is down 9 percent in the United States, up 70 percent in Japan, up 62 percent in the Soviet Union, and up 75 percent in West Germany.

It is terribly important to us in higher education, particularly in the research-type universities, that we stress basic research because, as you know, nearly all the basic research—that is, free, undirected research—in this country is funded by the Federal Government and fully half of basic research activities are conducted in university research laboratories.

When I refer to research universities, I want to support in the same context the very important 4-year colleges and smaller institutions, because they produce the people who become the graduate students, the professionals, and the university research investigators on our large campuses.

As you know, the Office of Management and Budget itself has strongly confirmed the Government's role in supporting basic research. They issued a policy statement a few years ago pointing out that basic research is vital to economic growth, that normal economic incentives will not produce an adequate volume of basic research in the marketplace. The lag between discovery and application is so long and unpredictable that only Government can supply the necessary support.

So I am asserting simply that along with manpower preparation of scientists and engineers, we need to continue to have the investment of dollars in the research activities of these scientists and engineers—and all that is human capital.

But there is another critical shortage that affects us in American laboratories, particularly university laboratories, and that is hardware, instrumentation. We have had an appalling decline in the quality of instrumentation in our laboratories and facilities. The whole system is decaying in comparison with those of Europe and Japan. In fact, it is an embarrassment when foreign visitors come to this country and are surprised at the antiquated equipment in our laboratories.

I happened to bring out this very point in testifying before this committee a couple of years ago, supporting more National Science Foundation funding for instrumentation. Congressman Ertel asked me this question at the time: "What are you, the University of Pittsburgh, doing about instrumentation?", and I did not have an answer. I asked my staff and they have finally come up with a number.

We are spending, at our university, about $5 million a year of hard money on obsolescent instrumentation.

If we were to embark upon a program—which we cannot possibly afford—of steadily replacing and modernizing instrumentation, we would have to double that figure, and in this day and age, with the shortages we have, that simply is not possible.

But what can be done about it? Well, I don't think even the Federal Government can afford to pay the bill.

We think that one of the critical opportunities and obligations is for scientists in universities and corporations to work together in common laboratories, with common equipment. This is a start. We can also think of improving instrumentation through tax incentives and depreciation allowances. We can foster limited industrial-educational partnerships that can take advantage of financial incentives provided by the Federal Government.

It happens that in the city of Pittsburgh, both the University of Pittsburgh and Carnegie-Mellon University have developed very, very important relationships with industrial research laboratories, and I think that pattern has to be repeated all over the country if we are going to begin to solve this problem.

So let me close by reemphasizing that the kind of research and training that occurs in higher education is crucial to the Nation's progress, and without a crop of exciting, new, dedicated young scientists, the productivity and prosperity of this country are destined to wane. Only basic research, science, and technology can bring about the improvement of productivity and prosperity that are so urgently needed.

The welfare of all Americans in the coming decades and the next century is inherently involved in issues being discussed here today, and that is why I and my colleagues firmly believe that support provided by the Federal Government to higher education and to basic research is a vital, indispensable, national investment.

Thank you.

[The prepared statement of Dr. Posvar follows:]

Remarks by Wesley W. Posvar, Chancellor, University of Pittsburgh, at the Hearing of the House Subcommittee on Science, Research, and Technology

February 11, 1982

Chairman Walgren and Members of the Subcommittee:

I am pleased to testify again before this subcommittee--especially in my home city--and I am gratified that you are meeting on the premises of the University of Pittsburgh. As your program indicates, colleagues of mine, faculty members of neighboring institutions of higher education, and representatives of industries in our area which rely heavily on advances in science and technology will discuss particular problems intensified by lack of funds for support of science and engineering education. I wish to speak briefly from an overall, national standpoint. In this brief foreword I will emphasize that partnership between the Federal Government, higher education, and industry is important to the future of this nation, and that research is the vital task.

Over the past several years, I have become concerned with the common interests of business and higher education in two special roles. One was as Chairman of the Business-Higher Education Forum, which is made up of chief executive officers of about 30 very large corporations and about 30 colleges and universities. The other, the AAU-DIR Working Group, includes several presidents from the Association of American Universities and several directors of industrial research of major corporations.

These key groups have been giving leading attention to science and engineering manpower needs and shortages, particularly in our major research universities. The role of these institutions is essential; the projected sharp decline in federal aid to their students would depreciate the future output of scientists and engineers needed to keep this nation on the advance in research and technology. (When I refer to universities, I credit the role of colleges which are the main source of the people who do graduate study and research in university laboratories.) Another concern is the already serious loss of science and engineering faculty members as they see more and more incentives to move to business and industry. Engineering and science faculty members constitute the "seed corn" for future industrial development; their loss has an adverse impact that will be felt deeply in years to come.

As we worry about our ability to train enough scientists and engineers for the future, we are really referring--in terms of economic analysis--to human capital.

Investment of capital in this country as expressed in real net addition to plant and equipment is less than 2 percent of GNP. Growth of GNP per worker is now zero. Yet capital formation is critical to everything else: it is the engine that drives productivity and employment, curbs inflation, corrects the balance of payments and could rectify or diminish many of our economic troubles.

Basic to all capital is human capital, and that is embodied in the output of higher education. Human capital--managers, engineers, scientists --must be developed before the physical capital--factories, laboratories, and technical services--can be meaningful. So I am concerned that lack of federal support for science and engineering will erode the very basis of our economic future.

The most important business of scientists is basic research. It is the cutting edge of progress. It is at this moment modestly encouraging that the nation's research and development spending as a whole rose for the fourth consecutive year--in real terms--and that basic research now accounts for

13.6 percent of the nation's R&D, the highest proportion in more than 15 years.

But the larger picture is grim; we are falling far behind the competition. During the period 1968-80 basic research decreased 16 percent as a fraction of the United States GNP. Research and development as a whole decreased by 19 percent. Meanwhile, research and development as a fraction of GNP went up by 19 percent in Japan, 14 percent in the Soviet Union, and 16 percent in West Germany. Scientists and engineers engaged in R&D, as a fraction of the labor force, went down by 9 percent in the United States, went up by 70 percent in Japan, up by 62 percent in the Soviet Union, and up by 75 percent in West Germany.

It is crucially important that we attempt to reestablish the United States as a world leader in science and engineering research, bolstered by our belief in a broad spectrum of higher education, as the generators of prosperity and quality of life. It would be tragic to jeopardize this goal by inadequate support for science and engineering teaching and research. In this respect, the role of the major research universities is vital; they perform 50 percent of the basic research in this country, and for the most part it is funded by the Federal Government, along with some support from foundations and corporations.

In these times of Federal Government retrenchment we must ask why should the Federal Government have the main responsibility in national support of basic research? The Office of Management and Budget looked at this question a few years ago, and in my view the answers set forth by the OMB have enduring validity:

— Basic research is fundamental to economic growth and the solution of important national problems.

- Normal economic incentives will not produce an adequate volume of basic research.
- The lag between discovery and application is so long and unpredictable that only government can supply the necessary support.
- Not all society, but mission-oriented federal agencies, such as the Department of Defense and the Department of Health and Human Services, are dependent upon the products of basic research to carry out their functions.

I have emphasized the human capital that is critical to economic growth and a high standard of living, and the manpower problem: The need for good students to be encouraged in their pursuit of science and engineering careers, and the need for outstanding engineers and scientists who will serve as their teachers.

Now I want to mention a deficiency in another capital element essential to research: the problem of instrumentation and facilities. The decaying instrumentation system in our American laboratories is on the verge of a national disgrace; foreign visitors from advanced-technology countries are surprised at the antiquated equipment they see here. The differences between their instrumentation and ours explains much of the higher productivity these countries have been showing. Seeking solutions, basic scientists in American universities and corporations are beginning to work together in common laboratories with common equipment. This is a start, but the government can help in improving instrumentation through tax incentives and fostering limited industrial-education partnerships that could take advantage of tax depreciation provisions.

We must recognize that the Federal Government alone cannot solve this problem. Congressman Ertel asked me the last time I appeared before this Subcommittee: "Apart from asking for federal support for instrumentation, what are you doing at your own institution?" I have an answer: We at the University of Pittsburgh spend on the order of $5 million annually on instrumentation. If we could afford a modernization program, we would easily spend $10 million annually.

The topics I have referred to here will be discussed in more detail by our panel members. But in conclusion I want to reemphasize the following point, simple but fundamental: The kind of research and training that occurs in the environment of higher education is crucial to the nation's technological progress. Without a continually renewed crop of well-trained and dedicated young scientists and their innovative ideas, both productivity and prosperity in this country will wane.

The welfare of Americans in the coming decades and in the next century is inherently involved in these issues. That is why I firmly believe that support provided by the Federal Government to higher education and to basic research is a vital national investment.

Mr. **Walgren**. That is a good statement, Dr. Posvar. It never ceases to amaze me how this administration does not recognize the Federal role in basic research or support for the universities.

As I understand our economic system, the marketplace would not drive those forces to levels that we truly need for national protection. And to see it rejected out of hand because it does not fit in their philosophy is very disturbing.

Dr. **Posvar**. Well, Mr. Chairman, given the overridding interest in national security, one has to think that in some instances there is an inadvertent lack of attention or overlooking of national priorities in certain very fundamental areas. It is true that the total NSF budget was not cut. It was slightly increased. We are pleased with the priority given in the budget to this area, although we had hoped for an even greater commitment to basic research.

However, foreign area studies, that is the training of experts in foreign languages and international relations, is absolutely vital to our Armed Forces, to our ability to foster international alliances to our capabilities in the international arena—and such capabilities could be virtually demolished by proposed budget cuts.

Yet nothing could be more cost-effective for national security than foreign area studies. I hope that someone will wake up and discover that the national security is being injured by this inattention to such matters.

Mr. **Walgren**. Well, I certainly hope that the Congress can provide some balance for that. One of the revelations in the discussions of the National Science Foundation budget last year was that the budget was drawn without regard for what people within the National Science Foundation felt was appropriate. In fact, it was even drawn without their input. And then it was imposed politically by being essentially substituted legislatively.

The administration's Office of Management and Budget decided priorities and sensitivities and the level of attention to be given to things like foreign language training. If there is one role the Congress could play, it should be to be able to develop the sensitivities of the wide range of interests in this society which could never be recognized by one group of budget people sitting down around the table.

That is why I am hopeful that the committee, in particular, will develop a strong case that will be respected in the Congress, because when we substitute a judgment of a small group of men we lose so much because their vision is not that broad. I suppose that is inherent.

Mr. Ertel, do you care to comment?

Mr. **Ertel**. Thank you, Mr. Chairman.

Doctor, you answered a question I posed to you some time ago. I appreciate that. You say you would need to double that amount to either bring your equipment or your levels up to what you think would be standard at least or progress to some degree. You indicated that you are looking at corporate help. Have you been successful? What kind of program do you have in place to increase your capacity and your abilities. If it is not in place, how soon do you expect it to be in place and can you use that as a model in the country?

Dr. **Posvar.** Well, a noteworthy example is a new surface science lab which we are just establishing with a half-million dollar support from the Gulf Oil Corp. This is a frontier-type research situation. We are putting out a lot of hard money in terms of renovation and investment in labs and so on, and we hope to get more money through contracts for sponsored research from other research-oriented companies.

This laboratory is just at its very beginning, and it does not call for any Federal funding at all.

Mr. **Ertel.** When you do this and you get involved with corporations, as I think you ought to, is there any restriction or requirement imposed upon the universities by corporations who contributed to these laboratories? In other words, do they direct the focus of your activities?

Dr. **Posvar.** No, they do not in this case. Our surface science laboratory will be totally controlled by the university. It will have open inquiry, with no more than brief restrictions that are proprietary. It will be an independent laboratory funded by the enlightenment of the Gulf Oil Corp. and others.

The American chemical industry has produced—you will hear other colleagues of mine who may know a lot more about these things than I do—the American chemical industry has come up with a superb proposal in association with universities for funding basic research at corporate expense for investigators in the chemical engineering and chemistry departments of major research universities throughout the United States. This program may be the most noteworthy example at the present time of university industrial cooperation in basic research.

We have discussed at length among university presidents the pitfalls and problems in joint university-corporate cooperation involving joint ventures and contracts where diverse interests must be brought into accommodation. One kind of accommodation is to provide that in any joint venture, the corporation will have the right to patent, but university investigators will be assured the right to reasonably prompt publication.

As long as we have the right to publication—open access—we have preserved a value that is critical to us.

Mr. **Ertel.** Thank you very much, Mr. Chairman. Thank you for your answer.

Mr. **Walgren.** Congressman Shamansky.

Mr. **Shamansky.** Thank you, Mr. Chairman.

I was extremely interested in your testimony. Recently the president of Ohio State University, Edward Jennings, came to Washington for a luncheon with the Committee on Higher Education and he pointed out that the equipment in the United States is almost two generations behind. It would take $50 billion just to update the laboratories. They are spending about $2 million a year and they wanted to put a special fund of $2½ million on top of it, but the State of Ohio is $1 billion behind and just coming on with very big cuts in the budget.

I thought you were really too kind when you suggested that perhaps the budget was inadvertent. I certainly do not want to——

Dr. **Posvar**. I am simply saying that if national security and national defense are indeed a top priority, the failure to stress foreign area studies is fundamentally inconsistent.

Mr. **Shamansky**. I do want to point out some of the things that we as a committee have to wrestle with, the committee last year put back the $50 million that the administration wanted to take out, but in the Gramm-Latta budget that was wiped out in one fell swoop.

So that is how we got the $21 million. In spite of our commitment, not because of it. We did not acquiesce except insofar as they had the big shootout among the budgets. That is what it is.

The administration, I must point out, still has its very special pets like the Clinch River breeder reactor. They put that back to the tune of $240 million. Mr. Stockman himself wrote a letter saying, in 1977, it is a turkey and should not get a penny. It is that kind of thing, and of the R. & D. money going into the energy field, I think 80 percent or more goes to nuclear power, to the regular fission things to the exclusion of almost everything else. It is almost an obsession with nuclear for the exclusion of everything else.

In a sense, I am begging you and your colleagues to make the case, not just to us because I can assure you it is perfectly obvious that we are convinced. But you have a number of Congressmen from the suburbs in this area who really need this message because it is the children of those people who need you here. And you are not going to be able to educate them.

Thank you.

Mr. **Walgren**. Thank you, Mr. Shamansky.

We appreciate very much your contribution, Dr. Posvar. Thank you very much.

Dr. **Posvar**. Thank you.

Mr. **Walgren**. The first panel represents universities and I would like to ask all three members to come up to the table.

Dr. Jerome Rosenberg, dean of the faculty of arts and sciences at the University of Pittsburgh; Dr. Daniel Berg, provost, Carnegie-Mellon University; and Kurt C. Schreiber, acting dean, graduate school, Duquesne University.

Gentlemen, we want to welcome you to the committee and again express our appreciation. Why don't we go through your statements sequentially in the order that they appear on the witness list and then we will have some discussions with the panel.

So if I could ask first, Dean Rosenberg.

[A biographical sketch of Dr. Rosenberg follows:]

DR. JEROME L. ROSENBERG

Dr. Jerome L. Rosenberg received his graduate training in physical chemistry at Columbia University, where his Ph.D. was awarded in 1948. During the 40's he was associated with the SAM Laboratories of the Manhattan Project in New York. He went to the University of Chicago in 1948 as an A.E.C. Postdoctoral Fellow in the Physical Sciences and remained there until 1953 as Research Associate (Assistant Professor) in the Insitute of Radiobiology and Biophysics. He joined the faculty of the Department of Chemistry at the University of Pittsburgh in 1953, and transferred to the Department of Biophysics and Molecular Biology as Professor and Chairman in 1969. His fields of research have included photosynthesis, photochemistry, and molecular spectroscopy. His published work includes numerous research articles, a pedagogical book in chemistry, and a non-technical book on photosynthesis.

Since 1969 he has been Dean of the Faculty of Arts and Sciences and he has also held the title of Vice Provost since 1978.

STATEMENTS OF DR. JEROME ROSENBERG, DEAN, FACULTY OF ARTS AND SCIENCES, UNIVERSITY OF PITTSBURGH; DR. DANIEL BERG, PROVOST, CARNEGIE-MELLON UNIVERSITY; AND KURT C. SCHREIBER, ACTING DEAN, GRADUATE SCHOOL, DUQUESNE UNIVERSITY

Dr. **Rosenberg**. Thank you, Congressman Walgren, and members of the subcommittee.

I will shorten the report of my prepared statement because you have already covered some of the ground that was contained in my statement.

Mr. **Walgren**. Let me say at the outset that written statements will be made a part of the record automatically and please proceed to summarize or communicate however you feel most effective in covering the area that you would like to cover.

Dr. **Rosenberg**. I wanted to begin by saying that there are some things that I think are going well in our system. At our university we have not had a problem of attracting students at the undergraduate level into science and engineering programs.

In fact, we have had increasing enrollments in these areas and in a broad based liberal arts college I really would hate to go above 50-percent science majors and that is about what we almost have right now. It is up from about 40 percent 10 years ago.

There may be some problems even at the undergraduate level looming ahead as a result of changes in the Federal student support programs, however, and I think that is a point that we have to be watching in the next year or two. I particularly am fearful that we will be set back in our efforts to increase the representation of blacks in our community of trained scientists and engineers. This has been a very difficult problem for the whole country and it is a problem that requires attention from the high school level on up. I am afraid that the diminution of student aid will make it particularly difficult to attract students, who by reason of educational disadvantage are in need of special programs, particularly many of our black high school students, into scientific and technologically based programs at the college level.

Our more serious problem with attracting students is the problem of attracting students at the graduate level and post-doctoral level. I think there are a number of reasons and I am not sure what all of them are. I think the Federal Government can help in some of these, but probably the problem is bigger than one that the Federal Government alone could deal with.

I think there is still a mistaken notion that there is a difficult job market for Ph. D.'s in science and engineering. Actually the contrary is true. There are many jobs going begging. There are many vacancies on college faculties that have not been filled in the science and engineering subjects because we have had too few students pursuing graduate work.

Another reason is that in fields where there are many opportunities at all degree levels, students are being siphoned off into the employment market at the bachelor's level and do not find enough incentive to move on for graduate study and research careers.

The school of engineering at the University of Pittsburgh currently has 10 vacancies. Some of these have existed for as long as 2 years in certain fields. It is interesting that when these positions are advertised, 95 percent of the applications in many instances come from foreign scientists.

Universities have, indeed, filled faculty positions with noncitizens. We are very pleased to attract foreign scientists when they are highly qualified, but we have increasing visa problems and I think we have increasing problems of building up the strength of American science and technology.

It is true that the predoctoral fellowship program of the National Science Foundation has been retained in the proposed Reagan budget. But even so, the predoctoral program is considerably below what it had been a decade ago.

In the biomedical fields we have had a big drop off of Federal support at the predoctoral level, particularly in the form of the NIH and NIMH training grant programs. These have been cut back very seriously and I understand that in the next year they are targeted to be cut back even more.

So we can look for increasing difficulties in attracting young people with good baccalaurate degrees and good basic training in biological subjects to enter graduate programs in preparation for research and teaching careers.

I think that the manpower legislation which your committee is sponsoring does have promise of addressing some of these problems. There are problems of encouragement in terms of fellowship support. There are problems in terms of mounting good national projections of needs.

For example, it has been well known that the national enrollments in engineering schools have gone through cycles of ups and downs and students are not wise enough to read the messages or notice what the market will be for a trained engineer 5 years after a student has to decide what to do in his professional preparation.

So we have had this mismatch repeatedly going through 7- or 8-year cycles. And when students refuse to enter engineering schools as freshmen because they see that particular year there are not a good many jobs, then we find that when the jobs open up we don't have the people to fill them.

Right now we are in the upswing in Pittsburgh and throughout the country. But I think that a systematic manpower council would be able not only to supply not only the good data and the good projections, but to help to provide the incentives to young people to choose fields for their own careers which are consonant with their own interests and talents and training, but also are consistent with national needs.

The other area that I had wanted to mention that makes it difficult to recruit faculty is the instrumentation problem the chancellor recently spoke of. One of the most exaggerated problems is in computer science. Computer science faculties have organized themselves into a national computer science board and they take stock every year of the number of Ph. D.'s being produced, the number of Ph. D's being sought by universities, and the number being sought by the national economy and society as a whole.

We have the mismatch by a factor of 6 to 1 in this field; that is, there are six times as many positions listed, for Ph. D.'s than we have new Ph. D.'s being generated to fill the market.

One consequence has been a leaking out of faculties from universities into industry, not only for more lucrative salaries, but more particularly for more attractive working environments in terms of modern computer equipment and facilities. The equipment backlog that the chancellor spoke about is one that affects the training of graduate students and affects the recruitment and retention of faculty as well.

Finally, I know that this particular hearing is conducted to refer to science education rather than research, but I do want to emphasize the linkage especially at the graduate level. The training of graduate students is closely linked to research. The training of a graduate student in research training and the health of our graduate educational programs cannot be separated or factored out from the health of the overall research effort at the university and in the country.

I think that we have problems. I think that the interesting suggestions of this committee as formulated in the bill for a systematic study and provision of incentives in the manpower area are interesting and useful new initiatives that may help to bring us out of some of the difficulties with which we are now faced.

[The prepared statement of Dr. Rosenberg follows:]

Statement of Dr. Jerome L. Rosenberg
Dean of the Faculty of Arts and Sciences, and Vice Provost
University of Pittsburgh
before the
Subcommittee on Science, Research and Technology
of the Committee on Science and Technology
U.S. House of Representatives
Hearing in Pittsburgh, Pennsylvania
February 11, 1982

I am pleased to appear before this subcommittee to describe some of the problems we are facing at our institution in science and engineering education and to point to some areas where we have benefited by partnership with the federal government and to some where this partnership needs to be strengthened.

First let me mention some successes. Over the past decade we have had a good and increasing flow of undergraduates into scientific and engineering fields. Ours is a comprehensive university where students have a free choice in selecting their majors, and they have been choosing engineering, mathematics, computer science, physical, biological, and behavioral sciences with increasing frequency over this period. A second sign of technological strength has been the steady growth of research activity, measured by either number of scientific publications per year, total annual research expenditures, or annual rate of federal funding through research grants or contracts. We are pleased that in gross figures the President's NSF budget for basic research for FY83 shows continued growth, at least in current dollars, and we note with satisfaction that attempts to withdraw funding disproportionately from the social and behavioral sciences have apparently been thwarted. There are weaknesses and danger signs, however, both in these and in other aspects of science education.

Undergraduate Education for Science

We in Western Pennsylvania share the national frustration over our inability to attract larger numbers of black students into science programs. To the extent that this results from a long history of social, economic, and educational disadvantage, we fear that the projected reductions in student aid for the neediest students and the phasing out of special opportunity programs may reverse the small gains we have made in bringing blacks into a fuller participation in science and technology-based careers.

For all of our undergraduates we are faced with a growing crisis of facilities obsolescence. Just as our society is caught up in a rapidly evolving scientific world, our colleges are enmeshed in serious financial problems which makes it difficult to provide laboratories that can train students for the new technologies. The imaginative NSF programs of the 60's and 70's, like the Science Development Program or CAUSE, are no longer available to encourage designated colleges selected competitively to participate through cost-sharing in curricular and instrumental innovation. Even the smaller scale Instructional Scientific Equipment Program for Undergraduate Science Education, under which our University has received support for five separate programs in the last three years, is to be eliminated next year. How will our colleges be able to provide for their students realistic models of the latest in interactive computing, in biopolymer separation, or in stress analysis without major outside help? I am not convinced that tax incentives for equipment contributions from the private sector will be enough; the results to date are not encouraging.

This country has been plagued over the past several decades with cycles of ups and downs in engineering enrollments that have characteristically been in mismatch with national needs because students enter their baccalaureate training with a perception of the existing opportunities when they are high school juniors or seniors rather than of the opportunities projected for the year in which they would receive their baccalaureate degrees. I am pleased that your Committee is considering a Manpower Bill which provides for defining a national manpower policy for the technological fields, one objective of which would be to relate training capacities and student recruitment to projected employment opportunities.

Graduate and Postdoctoral Education

As a nation we have been less successful over the past decade in attracting the most talented of our young people to pursue graduate degrees in scientific fields. There are complex reasons for this, including the competitive attractiveness of careers in the independent professions like law and medicine, the dire false warnings of poor employment prospects in college teaching and research, the lure of lucrative technical employment at the bachelor's or master's level, and the diminution of a national conscious awareness of the importance of research careers that peaked in the decade following the launch of Sputnik.

Our modern society needs more trained Ph.D.'s in many of the scientific fields than are now being graduated. In Computer Science, an extreme case to be sure, the ratio of demand to supply has been estimated to be close to six. We have the nationally competitive NSF predoctoral fellowships in the physical and mathematical sciences, that do help to encourage the best students to enter doctoral studies, but there are only a third the number that were awarded at the peak of the science boom and postdoctoral awards will be eliminated completely next year. The scope of the NIH and NIMH predoctoral and postdoctoral training programs in the biological and behavioral sciences has been drastically curtailed. Two years ago we had these training grants in four different programs in the Faculty of Arts and Sciences at the University of Pittsburgh; next year we will have no more than two and we are just as competitive as we ever were in terms of the intrinsic quality of our programs.

Graduate training in science is closely related to research. I know that research is not the principal subject of this hearing, but I do want to emphasize the linkage between graduate study and the vigor of research activity at a University. Graduate students must be assimilated into active research projects, and students usually gravitate to those universities and to those faculty sponsors whose research programs are externally supported, usually by the federal government. For experimental research problems the support is necessary to maintain the laboratory facilities; for either experimental or theoretical problems the support can provide a stipend for the graduate student. Thus, the social benefit of federal support of research at universities is not only the outcome of the research itself but also the training of a new generation of scientific investigators. I want to cite one special problem that is developing in experimental nuclear physics. The National Science Foundation currently supports about nine accelerator laboratories at universities. Productive work in nuclear physics is done at each of these. Because of projected budgetary problems, NSF is contemplating withdrawing its support from some of these laboratories and encouraging the facilities at those universities to redesign their research programs so that they could be carried out at the national laboratories, such as Brookhaven or Fermilab. Although this transfer of activity might lead to an improvement in cost effectiveness measured as the amount of research performed per dollar, there would be a clear loss in the capacity to train graduate students. At the University of Pittsburgh we are currently training a dozen students at our Nuclear Physics Laboratory; with the same faculty we could probably train only four or five at the national laboratories.

The shortage of graduate students, and thus of new Ph.D.'s, has caused a real national crisis in attempts to fill faculty positions. The University of Pittsburgh has had unfilled authorized faculty vacancies in engineering, computer science, coal geology, and nuclear physics in spite of vigorous recruitment searches that have extended up to four or five years in some cases. We are not unique. The capacity to maintain our teaching programs in these fields, at both undergraduate and graduate levels, is severely threatened.

Summary

We, as a nation, have become world leaders in many fields of science. For the past forty years we have dominated the Nobel laureate rosters and have been the chief exporter of science and technology. We have great fiscal and human resources with a tradition of considerable ingenuity. We have recently begun to lose some of this leadership, however, both in human creativity and in the technological marketplace. The loss is not irreversible, but the maintenance of a strong American science and technology requires a strong and enlightened national resolve.

Mr. WALGREN. Thank you very much, Dean Rosenberg. Next we will have Dr. Berg.

[A biographical sketch of Dr. Berg follows:]

DANIEL BERG

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Home Address:
1623 Branning Road
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Education:

B.S. City College of New York (1950)
(Physics and Chemistry)

Phi Beta Kappa (1950)

M.S. Yale University (1951) (Physical Chemistry)

Ph.D. Yale University (1953) (Physical Chemistry)

Graduated from Westinghouse Business Management Program
University of Pittsburgh (1953-1956)

Graduated from Advanced Management (Program for Executives)
Graduate School of Industrial Administration
Carnegie-Mellon University (1971)

Present Position

Provost, Carnegie-Mellon University (1981 –)
(Professor of Science and Technology)

Prior Positions

Dean, Mellon College of Science (1977-81)
(Professor of Science and Technology)
Carnegie-Mellon University

Technical Director, Westinghouse 1976-1977
(Adjunct Professor of Engineering, Carnegie-Mellon University
Adjunct Professor of the Graduate School of Industrial Administration, Carnegie Mellon University)

Manager, Energy Systems Research Division, Westinghouse 1974-1976

Director of Energy Research, Westinghouse 1969-1974

Manager of Insulation & Chemical Technology Department 1967-1969

Manager of Inorganic Materials, Westinghouse 1966-1977

Section Manager, Chemical Technology, Westinghouse 1964-1966

Section Manager, Physical & Inorganic Chemistry Section, Westinghouse, 1960-1964

Advisory Scientist, Westinghouse 1959-1960

Research Scientist, Westinghouse 1953-1959

Some Professional Activities and Associations:	Fellow - American Association for the Advancement of Science
	Fellow - Institute of Electrical and Electronic Engineers (Past President G-32)
	Fellow - American Institute of Chemists
	Ex-member of the Board - Pennsylvania Science and Engineering Foundation and Governor's Science Advisory Committee
	Editorial Board - Energy Systems and Policy
	Author of approximately 50 technical and management articles and books. Inventor of 14 patents.
Visiting and Review Committees:	Department of Commerce (Experimental Technology Incentives Program)
	National Academy of Sciences (Inorganic Materials - NBS, and Advanced Power Generation)
	DOE - ERAB Review Panel
	Yale University: Chemistry Department Chairman University Council on Sciences-Physical
	City College of NY: National Academy of Science and Engineering Review Committee
Consultation:	Various Industrial and Governmental Organizations — Including Lubrizol, Lord Mfg., Westinghouse, Monsanto, Wyoming Mineral, Copperweld, DOE, NRC, etc.
Boards:	Board of Directors; EIA Incorporated, Argonne Universities
	Science Advisor to various Boards of Directors and Science Advisory Council member of several corporations
Honors and Awards, Memberships	National Academy of Engineering (1976)
	Phi Beta Kappa
	Belden Prize
	Sigma Xi
	Alpha Chi Sigma
	Cosmos Club - Washington
	American Chemical Society
	American Physical Society

STATEMENT OF DR. DANIEL BERG

Dr. BERG. Thank you very much, Mr. Walgren, Mr. Ertel, and Mr. Shamansky. I am pleased to make a few comments. I don't intend to follow my printed remarks.

First, I would like to talk about the special education system required for science and engineering. Then I would like to talk about the impact at CMU of some of the recent budgetary changes.

I think we know that there are many good reasons to have a strong science and engineering educational system. Many of these are spelled out in the bill, H.R. 5254, and I think by your prior comments. They include productivity, innovation, world competitive strength and defense. To these I would add quality of life and an understanding of ourselves and nature.

There have been several comments made with regard to the marketplace. I think it is indeed true that if you give the marketplace enough time that this will all work out, but unfortunately there is a time lag involved that is literally at least a decade. Grammar students today who are not getting the proper science and mathematics training, will not end up in graduate school, literally 10 years away. If students are missing out on mathematics at an early stage, they are effectively foreclosing options that are not recoverable. It is clear to me, then, that the Federal Government has a crucial role to play in early education and specifically early education in science and engineering.

Further, I would like to support earlier remarks of you, Congressman Walgren and others that there is a crucial role that the Federal Government has to play with regard to a scientifically aware citizenry. We all know that there are all kinds of societal issues that require a greater understanding of science and technology on the part of the scientifically illiterate citizenry than currently exists. I think this is shocking, especially when we consider the economically competitive situation in terms of Germany and Japan, and the politically and militarily competitive situation with the Soviet Union. All that I have said I think argues for the bill, H.R. 5254. I think it is clear that we have to be anticipatory of events and societal requirements rather than reacting to a crisis situation when the system in place requires 10 years or longer to respond to our immediate needs.

Now, I would like to talk about a few impacts at Carnegie-Mellon. We all know that we are a special kind of school in many respects. We have an ongoing policy that any student that we accept on academic grounds, will be guaranteed, by CMU, the financial wherewithal to come and matriculate. This financial wherewithal may be a grant; a loan; or a job; or a combination of all these things. This guarantee is especially important because of the cutbacks in student loans. I would say there is a small panic among students who are applying to universities at the present time. To live up to policy, which we are still trying to do, we have had to increase our own commitment, that is, our own expenditures by about 50 percent from $3 million to well over $4 million in order to allow financially restricted students to come to CMU.

Overall, as a university, we are still in an exceptional position because of the very large industrial support, alumni support, and endowment support that we get, but, having said all of that, there remains significant uncertainties surrounding our future.

One case in point, is our Robotics Institute which is supported both by industry and Government. Clearly, this is an area of our expertise because of our technological background, and our expertise in computer science and artificial intelligence. This is an area that we hope to expand. To do this, we require room for expansion. We have been negotiating with the Bureau of Mines for the property that they would like to give up. We are now concerned just where we are going to get the money to pay this expansion, given the need to use our own funds to replace grants and loans that students would otherwise get from the Government.

Dean Rosenberg mentioned and I want to second his comment concerning the impact on minorities and women, especially in graduate science and engineering education.

It has been our observation that the minority students who go through our system and do quite well are in very strong demand in industry. Because of giving up of another 4 or 5 years to get a Ph. D. and really to struggle through at economically depressed salaries, many have elected to go into industry

Other areas of our concern include the fact that we have expanded our biological activities in molecular and cellular biology in response to educational and scientific demand and we are very much concerned about Federal support in these areas for what we consider our brilliant young faculty.

As you all know, we have already seen the impacts of Federal curtailments on our social scientists. I think the country is going to feel the results of that in another decade. I think that will result in a lowering of the quality of research. We are going to see, unfortunately, and we are going to see when it is too late.

Let me give you a left-handed view of what is going on in this regard. Frankly, we have benefited by the cutbacks in a lot of universities throughout the country. We have been able, because of our own peculiar nature, namely, well known in engineering and highly coupled to industrial support, we have been able to hire outstanding faculty from major national institutions, institutions that no longer can afford to keep them because of retrenchment. So on a microscale, we have benefited, but I assure you the country has not. We just happen to be lucky because we are in the right area today and are getting top students for whom the demand has been very high. It has also, however, required special requests for alumni support by our president, getting jobs for students, instituting CMU job programs, and using our endowment money to meet our philosophy of matriculating anyone academically qualified.

Again, I think we have been well supported by industry and clearly we are accenting this even more. As a result, our engineering activities have been doing exceedingly well, but the basic research areas, especially in certain areas, are not doing as well. It is clear that DOD is going to increase their funding in the basic research areas, but some areas of basic science are in trouble. This is primarily true in physics, parts of chemistry, and as I alluded before, the social sciences.

When we talk about science, from science to marketplace, we are talking decades. When we are talking about graduate school students becoming working scientists and engineers, we are talking about a single decade. But the time required for basic science to impact the marketplace is at least several decades.

I hope I have covered with a few points things that lead me to conclude that H.R. 5254 is very much needed, I have also tried to cover some current and anticipated impacts at CMU. Unfortunately, some of these effects we won't see for a decade and by then I am afraid it will take a long, involved, and expensive process to rectify.

Thank you.

[The prepared statement of Dr. Berg follows:]

Revised
2/10/82

THE IMPACT OF REDUCTIONS IN FEDERAL PROGRAMS SUPPORTING SCIENCE AND ENGINEERING EDUCATION AND THE "NATIONAL ENGINEERING AND SCIENCE MANPOWER ACT OF 1982" H.R. 5254

My name is Daniel Berg, I am Provost of Carnegie-Mellon University specifically responsible for the science and engineering colleges and Mellon Institute, our Institute heavily directed toward industrial sponsored research. I also have the assignment of research for the whole campus, and I'm directly involved in our Robotics Institute.

I appreciate the opportunity to give some comments concerning the impact of reductions in Federal programs supporting science and engineering education.

Today I only want to make a few points on this subject, which I think has been fairly well explored. The first point, a traditional one, is that the market place will eventually take care of our need for scientifically and technologically trained personnel. This will come about because the increasing shortages of these people will cause the salaries to rise and students will see, as they already have, that there are shortages and will start studying the right fields and eventually get the graduate training that is required to go out into the work force. Unfortunately, in a real and current context, there are several impediments to this happening.

One involves the current trend to increasingly limit accessibility of students to whatever education they need by across-the-board cuts in student financial aid, including loans.

Exacerbating this is a beginning trend on the part of universities to charge tuition rates that vary among disciplines, rates that are, it is argued, more reflective of the real cost of the education and the income benefits a student will receive. Since science and technological educations are more expensive to provide it is likely the cost to the student will rise at a faster rate than for education in general.

Finally, if the current tendency toward decentralization of education and educational policy continues, it will be increasingly hard for national educational needs to surface and to be responded to. Regional or local systems will respond most directly and quickly to regional problems. There is currently no market place guarantee that national and local priorities in an environment of limited public responses will be complimentary to, or supportive of, each other.

Additional problems exist. Even if the system is responsive to national priorities, there is a significant time lag between recognition of need and the graduation of appropriately educated people. The groundwork for a good scientific and technical education begins in grade school. If it begins later, a good deal of catch-up must occur. Additional resources, expended in a much shorter period of time, must be allocated. Options for students are foreclosed if students miss out on mathematics at an early stage.

I am making the point, first, that the Federal government should play, needs to play, a crucial role in promoting the general welfare and providing for the defense of this country, and, secondly, that a vital element in this role is in seeing that our educational system, in this case for engineering and science, is appropriate for our current and future needs.

I think we here all agree that science and technology education are of fundamental importance for our society and of fundamental importance to maintaining, improving and expanding our infra-structure. Clearly the Administration's search, and our nation's requirement for, improved productivity, new industries, improved health, and improved military capabilities, has at its core the need for a highly competent and expanding group of scientifically and technologically trained individuals.

I have seen, recently, figures from the American Electronics Association which state that in the field of electronics and computers alone, only 1/3 of the engineers needed by 1985 will be available, namely about 70,000 of 200,000 electrical engineers and computer science graduates, needed by them, are presently in the educational pipeline. This figure of 70,000 graduates can be compared to the quarter of a million graduated, per year, in the Soviet Union. In Japan, which has a population approximately 1/2 our size, they are actually graduating about 25% more engineers, per year, than we are.

I think it is clear that if science and mathematics are weak in grade school and high school, then we are going to end up with inadequate numbers and inadequately trained scientists and engineers a decade hence. I think one of the tragedies of these budget reductions is cutting the early education as well as cutting the support for undergraduate and graduate education.

To reiterate, the Federal government, specifically the National Science Foundation, plays a critical and inherently unique role in curriculum development, teacher training, etc. The talk at this time that we have to curtail the Federal budget should not become an excuse for our abrogating our responsibilities as a nation to provide for our continued strength and growth.

There is another point though that should be made. If competently trained scientists and engineers are at the core of our continuing prosperity, a scientifically aware citizenry is at the core of a responsive and, effective voting population. Scientific and technological illiteracy among the general population could lead to disasterous public decisions on such things as energy. So I think budget cuts that decrease the ability of our high schools and grade schools and colleges to function are a disservice to the nation. I am pleased to see that a variety of states are starting to support new programs for science and technology because they see the crucial importance to the economic well-being of the state. Just recently Pennsylvania has announced an attempt to establish a summer Science High School for gifted high school students. I applaud this. I think it is highly desirable and quite welcome. However, I think in addition, there is a need for a Federal concern for the wealth and vitality of our scientific literacy.

All these factors, the need for an effective national science and technology policy; the impossibility of playing catch-up once an early scientific education has been denied; the need for a highly competent and growing scientific and engineering community; and the need for a society knowledgeable about scientific and technological needs and concerns; argue for the passage of Act H.R. 5254.

Clearly, we need some kind of planning which anticipates, rather than reacts to system needs. The inherent time lag within a decentralized, diffuse system in surfacing and articulating science and technological needs and priorities, if left to chance, creates problems we cannot afford. Therefore it seems to me this Act is very desirable.

Mr. WALGREN. Thank you very much, Dr. Berg.

Third, Dean Schreiber from Duquesne.

STATEMENT OF KURT C. SCHREIBER

Mr. SCHREIBER. Thank you very much.

Representative Walgren, distinguished panelists, ladies and gentleman, my name is Kurt C. Schreiber. I am the acting dean of the Graduate School of Liberal Arts and Sciences at Duquesne University. I first joined the Duquesne faculty in 1951, and my work at the university includes 15 years as chairman of the department of chemistry and 5 years as assistant dean of the college of liberal arts and sciences, at which time I was responsible for coordinating the activities of the departments of biology, chemistry, mathematics, and physics. I hold the rank of professor of chemistry.

Duquesne University is a private, independent institution located in Pittsburgh, Pa. It was founded 103 years ago, and presently offers programs on the baccalaureate, master's, doctoral, and professional levels in its eight schools of study: The college of liberal arts and sciences, the graduate school of liberal arts and science, the school of law, the school of business and administration, the school of pharmacy, the school of education, the school of music, and the school of nursing.

In addition to its liberal arts and social science programs, the college of liberal arts and sciences offers the following natural and applied science majors on the undergraduate level: biochemistry, biology, chemistry, computer science, liberal arts/engineering, mathematics, and physics. On the master's level, programs in these areas include biochemistry, biology, chemistry, mathematics, pharmaceutical chemistry, pharmaceutics, pharmacognosy, pharmacology, and toxicology. Doctoral level programs in the sciences include chemistry, medicinal chemistry, and pharmaceutical chemistry.

Our purpose in participating in today's hearing is, first, to express our deep concern as members of the scientific and academic community on the impending budget reductions in the fields of the natural and applied sciences, and second, to voice our position on the proposed House bill, H.R. 5254, as introduced by Representatives Walgren and Fuqua.

Duquesne University is primarily a teaching oriented rather than research intensive institution. Our science majors are fewer in number than at our sister institutions of Carnegie-Mellon and the University of Pittsburgh, nor are we as deeply involved in intense research activities.

Because of our emphasis on a broad based, liberal arts education, however, Duquesne is affected in ways that are different, more subtle, but no less serious than those experienced by institutions with greater commitments to research.

In addition to our science majors, other students majoring in other areas who are required to take 2 years of science as part of their graduation needs are affected by the quality of instruction and the learning experience in the natural sciences. Add to this number those students in our school of education preparing themselves for careers as elementary and secondary school teachers in the sciences, and it is obvious that any factors affecting the quality of the science curriculum at the university will also influence a much broader spectrum of students than only those majoring in the sciences.

One of the primary concerns in the natural sciences at Duquesne has been the pressure to keep pace with the growing technological acumen demanded of our graduates for placement in either industry or graduate degree programs. The practical aspects of science education at Duquesne are integrally related to the theoretical aspects precisely because of the applied nature of scientific disciplines. While the quality of our faculty and their teaching proficiency remain excellent, the overall quality of the learning experience in the sciences could be seriously impaired by a general decline in the quality of practical "hands on" experience available to our students.

The practical aspects of a scientific education are closely tied to the availability of scientific equipment that is not only operable but in step with the level of technological advancement that we have reached.

In the most recent report submitted in 1977 by the University to the Commission on Higher Education of the Middle States Association, a consistent theme was expressed by all of our programs in the natural sciences: Years of use and rapidly changing technologies regularly render much of our instructional equipment obsolete. The university has expended considerable portions of its own funds—as well as relying on industry support—to replace or restore vitally needed instructional equipment, but the struggle to provide instrumentation that is in step with our present level of technology grows increasingly difficult with each technological advance and the spiraling cost of such equipment.

The equipment used in science education is directly related to the curriculum. Serious deficiencies in instructional equipment not only impede the quality of education offered, but also serve as an obstacle to the development of new and challenging curriculum.

Perhaps one facet of the problems created by the current budget rollbacks that is often overlooked or little understood is the human element, particularly as the cuts may affect the recruitment and retention of students. Students are affected not only by declines in the overall quality of university science programs, but in the shrinking funds available for various forms of financial aid.

At a time when experienced researchers are needed as never before to keep pace with the rapid developments in technology and to enable this country to compete with foreign nations whose technological manpower, know-how, and production challenge and exceed our own, we are witnessing a disturbing decline in both the number of and percentage of students who pursue graduate study in the sciences.

The reduction of funding for financial aid works an especially difficult hardship on private institutions like Duquesne, which has a small endowment and a pattern of steadily increasing costs common to private higher education. With the rising costs of attending a private university, it is essential that in addition to retaining the highest possible quality and standards academically, institutions themselves remain financially accessible to as many students as possible.

Declining funds for financial aid, more specifically, most severely affect such groups as women and minorities. In the graduate chemistry program at Duquesne, for example, a nearly even ratio now prevails between male and female students—a balance which will almost surely be upset by substantial reductions in financial aid.

Moreover, the declining availability of funds for both student aid and academic programs will likely impair the university's ability to attract foreign students, especially those from underdeveloped and disadvantaged nations, a priority institutional goal established by Duquesne's President Rev. Donald S. Nesti.

In a January 4 article published in the Washington Post, President Reagan's science adviser, Mr. George Keyworth, noted that abundant funding cannot produce good science, saying, and I quote, "that it can even produce mediocrity rather than stimulate excellence."

While I wholeheartedly endorse Mr. Keyworth's comments, I also hasten to add that we presently are not dealing with abundant spending in the sciences, but rather with minimum funding levels. And just as careless and frivolous spending can lead to mediocrity, the denial of funding for worthy and indeed basic projects can lead to a loss of initiative, and, ultimately, quality in our classrooms and laboratories.

The National Science Foundation recently indicated in the February 3 issue of the Chronicle of Higher Education that the number of research proposals received has dropped sharply from 1,200 to 800 this past year as a result of the Reagan budget proposals.

While the NSF budget has been cut, funding is not as low this year as had been anticipated by the science community. Discouraged by these proposals advocating severe cuts, however, many researchers assumed that funding would not be available for their projects and opted not to submit any proposals for review.

To enlarge on this point, Pittsburgh's Health Research and Services Foundation of the United Way has reported that its 1982 health projects budget was reduced by $51,000 from the 1981 level by action of the HRSF board in response to a corresponding restriction in the United Way's allotment to the HRSF.

With the anticipated reduction in social service support by the Federal Government, community agencies like the United Way are expected to increasingly channel their funds into these areas and reduce their support of related programs like HRSF. In announcing the reduction in this year's funding, the HRSF Board stated that of the 143 proposals received, only 30 could be approved for funding, although an additional 27 were deemed worthy of support had sufficient moneys been available. Seven of those proposals happened to be from Duquesne.

In 1980, four Duquesne programs received HRSF funding. I personally fear that this "chilling" effect on quality scientific proposals and the underlying spirit of scientific inquiry will persist until renewed signs of support and serious commitment for research become evident once more.

There are, I believe, some unrealistic expectations shared by both government and the scientific community on the role that industry should assume in supporting future research. Duquesne University has been the recipient of productive and innovative research grants funded by industry, and these grants have provided us with considerable equipment and instructional support. However, the scientific community simply cannot rely entirely on industry when other interests are doing the same.

We are now turning to industry to support our fine arts, our ballets, our symphonies, our museums. We in academia turn to industry for endowment support, faculty development funds, student scholarship moneys—the list is endless, while the resources of industry obviously are not.

I most certainly advocate and encourage a strong and ongoing interaction between the academic and science communities with industry, but it is simply shortsighted and unreasonable for us to depend on its support alone for our continued development and progress. It would, for example, seem logical for government to at least provide increased seed moneys for initial program development, with universities then seeking additional funds from the private sector.

The administration and scientific community at Duquesne University join in enthusiastically endorsing House bill H.R. 5254 for its effort to establish a national policy for engineering, technical, and scientific manpower. We applaud its goal of creating a much needed national coordinating council on engineering and scientific manpower.

We would like to express our particular support of Representatives Walgren and Fuqua's attempt to address the persistent decline in the mathematics and scientific skills among our Nation's primary and secondary students. It is increasingly apparent to us that today's students are entering their college careers with very weak foundations in the natural and applied sciences, and on a short-term basis, we at the university level must be prepared to offer these students basic training in these areas so that they can qualify either for advanced degree work or for responsible career positions in science or industry.

We should also offer expanded training programs for elementary and secondary school teachers in the sciences so that they can better prepare students for the more rigorous demands of the sciences during their college years. Once at the college level, students should be prepared and encouraged to explore the possibilities of graduate study for the research and teaching expertise that is so desperately required by the scientific community of the present and the future. It is our feeling that House bill H.R. 5254 offers the groundwork needed to achieve these goals.

I thank you for the opportunity to present this testimony for your consideration and review, and I would be happy to answer any questions.

[The statement of Mr. Schreiber follows:]

DUQUESNE UNIVERSITY
Pittsburgh, Pennsylvania

ORAL COMMENTS ON PROPOSED REDUCTIONS IN SCIENCE EDUCATION AND ON THE RECOMMENDATIONS OF H.R. 5254

DELIVERED AT HEARING, PITTSBURGH, PENNA.

FEBRUARY 11, 1982

Representative Walgren, distinguished panelists, ladies and gentlemen: my name is Kurt C. Schreiber. I am the acting dean of the Graduate School of Liberal Arts and Sciences at Duquesne University. I first joined the Duquesne faculty in 1951, and my work at the University includes 15 years as chairman of the Department of Chemistry and five years as assistant dean of the College of Liberal Arts and Sciences, at which time I was responsible for coordinating the activities of the Departments of Biology, Chemistry, Mathematics and Physics. I hold the rank of professor of Chemistry.

Duquesne University is a private, independent institution located in Pittsburgh, Pennsylvania. It was founded 103 years ago, and presently offers programs on the baccalaureate, master's, doctoral and professional levels in its eight schools of study: The College of Liberal Arts and Sciences, the Graduate School of Liberal Arts and Sciences, the School of Law, the School of Business and Administration, the School of Pharmacy, the School of Education, the School of Music and the School of Nursing.

In addition to its liberal arts and social science programs, the College of Liberal Arts and Sciences offers the following natural and applied science majors on the undergraduate level: biochemistry, biology, chemistry, computer science, liberal arts/engineering, mathematics and physics. On the master's level, programs in these areas include biochemistry, biology, chemistry, mathematics, pharmaceutical chemistry, pharmaceutics, pharmacognosy, pharmacology and toxicology. Doctoral level programs in the sciences include chemistry, medicinal chemistry, and pharmaceutical chemistry.

Our purpose in participating in today's hearing is, first, to express our deep concern as members of the scientific and academic community on the impending budget reductions in the fields of the natural and applied sciences, and second, to voice our position on the proposed House Bill 5254 as introduced by Representatives Walgren and Fuqua.

Duquesne University is primarily a teaching-oriented rather than research-intensive institution. Our science majors are fewer in number than at our sister institutions of Carnegie-Mellon and the University of Pittsburgh, nor are we as deeply involved in intense research activities. Because of our emphasis on a broad-based, liberal arts education, however, Duquesne is affected in ways that are different, more subtle, but no less serious than those experienced by institutions with greater commitments to research. In addition to our science majors, other students majoring in other areas who are required to take two years of science as part of their graduation needs are affected by the quality of instruction and the learning experience in the natural sciences. Add to this number those students in our School of Education preparing themselves for careers as elementary and secondary school teachers in the sciences, and it is obvious that any factors affecting the quality of the science curriculum at the University will also influence a much broader spectrum of students than only those majoring in the sciences.

The quality of the science curriculum on the undergraduate level at a teaching-oriented university is a serious consideration for another reason. The Scholastic Aptitute Test (SAT) scores of recent years indicate a continuing decline in the science and mathematics skills of incoming freshman students nationwide. Education in the sciences at the college level, therefore, becomes especially crucial as a means of correcting deficiencies in the academic backgrounds of students as well as a final preparation for a career in the sciences or graduate study, where the emphasis shifts to research.

One of the primary concerns in the natural sciences at Duquesne has been the pressure to keep pace with the growing technological acumen demanded of our graduates for placement in either industry or graduate degree programs. The practical aspects of science education at Duquesne are integrally related to the theoretical aspects precisely because of the applied nature of scientific disciplines. While the quality of our faculty and their teaching proficiency remain excellent, the overall quality of the learning experience in the sciences could be seriously impaired by a general decline in the quality of practical "hands on" experience available to our students.

The practical aspects of a scientific education are tied closely to the availability of scientific equipment that is not only operable but in step with the level of technological advancement that we have reached.

In the most recent report submitted in 1977 by the University to the Commission on Higher Education of the Middle States Association, a consistent theme was expressed by all of our programs in the natural sciences: Years of use and rapidly changing technologies regularly render much of our instructional equipment obsolete. The University has expended considerable portions of its own funds -- as well as relying on industry-supported research activities -- to replace or restore vitally needed instructional equipment, but the struggle to provide instrumentation that is in step with our present level of technology grows increasingly difficult with each technological advance and the spiraling cost of such equipment.

That the scientific equipment used in the learning experience must be as compatible with our current level of technology as the instrumentation used in actual research should be apparent. The equipment used by students in the sciences is their most direct, tangible link with the reality of the scientific and industrial world that they will enter upon graduation. A student's motivation for learning must be strained at the very least by the realization if the equipment used in the classroom is already obsolete and irrelevant to the world of science. The equipment used in science education is directly related to the curriculum. Serious deficiencies in instructional equipment not only impede the quality of education offered, but also serve as an obstacle to the development of new and challenging curriculum programs for students.

Perhaps one facet of the problems created by the current budget rollbacks that is often overlooked or little understood is the human element, particularly as the cuts may affect the recruitment and retention of students. Students are affected not only by declines in the overall quality of university science programs, but in the shrinking funds available for various forms of financial aid. At a time when experienced researchers are needed as never before to keep pace with the rapid developments in technology and to enable this country to compete with foreign nations whose technological manpower, know-how and production challenge and exceed our own, we are witnessing a disturbing decline in both the number of and percentage of students who pursue graduate study in the sciences. While the lure of lucrative salaries from American industry has certainly contributed to this pattern, the tendency for so many undergraduate science majors to forgo graduate study must necessarily raise serious reservations about the perceived value and relevance of an advanced degree in the sciences among many of today's students.

The reduction of funding for financial aid works an especially difficult hardship on private institutions like Duquesne, which has a small endowment and a pattern of steadily increasing costs common to private higher education. With the rising costs of attending a private university, it is essential that in addition to retaining the highest possible quality and standards academically, institutions themselves remain financially accessible to as many students as possible.

Declining funds for financial aid, more specifically, most severely affect such groups as women and minorities. In the graduate chemistry program at Duquesne, for example, a nearly even ratio now prevails between male and female students -- a balance which will almost surely be upset by substantial reductions in financial aid. Moreover, the declining availability of funds for both student aid and academic programs will likely impair the University's ability to attract foreign students, especially those from underdeveloped and disadvantaged nations, a priority institutional goal established by Duquesne's President Rev. Donald S. Nesti, C.S.Sp.

Academic programs in the sciences are not only more costly for the University to maintain, but more expensive for students as well. Not only does an education in the sciences include additional costs such as laboratory fees, but additional years of study (as in the case of the five-year program in Duquesne's School of Pharmacy). Among Duquesne's graduate student body, approximately 18% are enrolled in the sciences, with 60% of that number being full-time students. Students in these graduate programs would almost surely be the first and most seriously affected by cutbacks in federal funding. With graduate enrollments already down 1.1 percent this past year across the nation (the lowest drop in the last five years), this fact is of special concern to institutions which offer advanced studies in the sciences.

In a January 4 article published in the Washington Post, President Reagan's science advisor, Mr. George Keyworth, noted that abundant funding cannot produce good science, saying -- and I quote -- "that it can even produce mediocrity rather than stimulate excellence."

While I wholeheartedly endorse Mr. Keyworth's comments, I also hasten to add that we presently are not dealing with abundant spending in the sciences, but rather with minimum funding levels. And just as careless and frivolous spending can lead to mediocrity, the denial of worthy and indeed basic funding projects can lead to a loss of initiative and, ultimately, quality in our classrooms and laboratories.

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The administration and scientific community at Duquesne University join in enthusiastically endorsing House Bill #5254 for its effort to establish a national policy for engineering, technical and scientific manpower. We applaud its goal of creating a much-needed national Coordinating Council on Engineering and Scientific Manpower. We would like to express our particular support of Representative Walgren and Fuqua's attempt to address the persistent decline in the mathematics and scientific skills among our nation's primary and secondary students. It is increasingly apparent to us that today's students are entering their college careers with very weak foundations in the natural and applied sciences, and on a short-term basis, we at the university level must be prepared to offer these students basic training in these areas so that they can quality either for advanced degree work or for responsible career positions in science or industry.

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I thank you for the opportunity to present this testimony for your consideration and review, and I would be happy to answer any questions.

Mr. **Walgren**. Thank you very much, Mr. Schreiber.

The continuing theme of the marketplace fixes on supply, and this is doing damage to our ability to train in the time of shortage. It pulls people out of universities and into industry to meet those needs which would have a higher financial reward. I can't get over the feeling that this is an area where Government is neither good or bad, but rather a piece of the puzzle that can be helpful. If we approach it as something the Government should not be involved in at all, we really expose ourselves to some self-defeating cycles that could be very damaging if you miss a period of 4 years or something like that, economically, and Japan or other international competitors come in with the technology where they have the capacity and we are just in the downside of our cycle, it really damages our national prospects.

I can't help but remember on the floor of the House of Representatives the argument from the other side being, let's show the country that we are going to get the Government off their backs and therefore cut the National Science Foundation budget.

Would you gentlemen just briefly indicate whether we are in a much more complex world than that. And have you seen solid contributions that we have been able to do together, through Government, that we would not have been able to do just following the marketplace?

Dr. **Rosenberg**. Well, I think the intervention of the Government following World War II in supporting science has been one of the major governmental contributions to our life over the last three decades.

Even before the National Science Foundation was begun, the Office of Naval Research took up the slack, recognizing that something had to be done to support basic work at the universities.

I agree with you that with respect to the role in manpower planning the Government is not going to solve all problems. It is a sensitive problem. This is not a totally planned society and none of us wants it to be. We do not want to be in a position of assigning to each high school senior his role for the rest of his life.

But I agree with you that the Government's help and leadership in predicting needs and providing the wherewithal for the students to follow their own talents are certainly areas that will make major contributions toward solving these problems.

Mr. **Walgren**. Thank you.

Dr. **Berg**. I would like to add a few comments, Congressman Walgren. I think, specifically, the National Science Foundation plays a criticial and catalytical role in many areas. I think, for example, there are national issues localized, each little issue is not big enough to devote the trained talent, time, and resources to develop teacher training, curriculum development, laboratory systems. By just passing it down to the State and the State to the bureau and the bureau to the teacher, it just does not get done.

Consequently I think it is clear that there is an obvious role in providing the effectivness of our system for the National Government and specifically for NSF.

Mr. **Walgren**. Thank you.

Mr. **Schreiber**. I would like to add another point. There is a very important psychological impact here. When the Federal Government says, well, we can afford to do away with science education, do away with the National Science Foundation, we are telling the students that are coming up, science, technology, engineering, are not important in our national priorities. And I think one of the underlying, perhaps not visible reasons for students staying away from science and engineering curriculums is the psychological effect that they think, that is not really important in the priorities that our Nation has.

Perhaps there is one other item that should be mentioned. We talk a great deal about national security, defense, and there is no question that this is important and vital. However, I think there is another aspect of national defense and security that is involved. There is a short-range view and a long-range view. The reason that we are strong is because of the scientific and technological achievements that our country has accomplished over the last 30 years since World War II.

The students who are today starting their elementary education are the scientists, the engineers of the first quarter or perhaps first half of the next century. If we do not attract at least a sizeable number of those outstanding young people into the sciences and into engineering, then we may win the short-range battle, but would lose the war.

We will not be able, scientifically, to compete with the Soviet Union in the next century.

Mr. **Walgren**. Thank you very much.

In the interest of time, I will suspend.

Congressman Ertel?

Mr. **Ertel**. Thank you, Congressman Walgren.

Listening to Dr. Berg as he was indicating his university is getting better professors from other universities indicates to me, of course, that there is a cutback in the other universities in adequate funding and therefore, the flow of people. I think that is a poor commentary on American education. I don't know if you would agree with me, but I would like to just say something to you and see what you think.

I think the greatest thing that ever happened in this country was the GI bill after World War II, because it brought into the educated realm an entire new group of people who had never been educated before.

The comprehension of society had changed, and they became a new middle class, if you will. We expanded that middle class and really, basically, changed the structure of America.

When the GI bill started to phase out, we changed that structure of America even more with guaranteed student loans and other programs. We expanded the GI bill to include women. There was no ultimate. We started to make it much more of a universal educational system at the undergraduate and even at the graduate levels.

The science education that we are talking about today is a particularized part of that. We were trying to bring our society along and to make a better, more uniform education background.

Now, it seems to me, our Nation is starting to turn back. It is not one of the new deals we are talking about. We are turning back the clock, if you will, trying now, maybe not intentionally, but that is what the effect would be, to eliminate those areas of progress we have achieved in such a short period of time, 30 years in this Nation.

Look at the level of science and engineering education funding by programs for a moment. The estimate for 1983 is zero for faculty improvement. Graduate research fellowships, have $15 million, but for student oriented programs, zero. Minorities, women, and physically handicapped, zero; science education resource approval, the entire program, zero. Science education and development research, the entire program, zero.

Science education communication, one of the things you spoke about in trying to get the younger people interested in science, public understanding of science, zero. Information dissemination for science education, zero. Programs administered, zero. The Commission on Pre-College Education, zero.

Where are we going in this country? We have talked about industry filling the gaps. Will industry fill any of those gaps? Does industry even have an obligation or responsibility to fill those holes or is it Government's responsibility? What is your view.

Dr. ROSENBERG. Well, I agree with you, Congressman Ertel, that this does represent the turning back of the clock. Obviously, we at the universities will try to keep up the pace of science education, but without some Government help we will have to look for alternate forms of help. Whether the States will pick up the gap, I don't know. I frankly am skeptical that the States will in all of these areas.

I also feel that the universities have a matter of resolve which can be brought to bear on the problems of science education and we can set a tone for the secondary school system of the country. And with or without Federal support, I think there are things that we can do to publicize the values of science. We have just revised our curriculum at Pitt, for example, to insist that every liberal arts student have more serious exposure to scientific values and scientific concepts than had been required previously.

And we hope that this will have an impact on the way science is viewed in the public schools.

But I agree with you that in many areas like the undergraduate instructional equipment program that is being chopped off it will be difficult to continue without dollars from some other source. I desperately urge Members of Congress to look at the total needs that we have in many of these areas.

Dr. BERG. With regard to your question, Congressman Ertel, about business filling the gap, I think there are many enlightened industrial organizations that are doing things. But I think the gap is just so large that it is not conceivable to me that they are going to fill the gap. I think there are a number of healthy things happening in the interactions of industry and universities. I don't think and I don't see that in truly fundamental work that the industries are going to fill that gap. I also note that there are going to be other reactions, by a number of other people. States are starting to try to do things because they recognize that science and technology are very important to the economic well-being of the State. You are seeing some responses, to these effects, but I don't think that when you add them all up that they are going to make an impact that approaches the impact of decreased Federal dollars and commitments. It just seems to me that the Federal Government is, in part, turning its back on what I consider is not only a constitutionally mandated responsibility, but a core responsibility. Others may partially fill the void but I really don't see them making up our losses, either in level or in type.

Mr. **Schreiber.** I would agree with the comments that have been made by Dr. Rosenberg and Dr. Berg.

One aspect of this filling the gap is in Pennsylvania, for instance, that we finally have moved to the point where we will establish a summer school for science for highly talented high school students.

This is a movement in the right direction. But, again, I think when you look at the total gap that is being created it is not going to be filled by States and industry. We will need a joint effort between Federal Government, State, and industry to move ahead.

Thank you.

Mr. **Ertel.** It seems to me that you all agreed with my basic proposition.

Now, the question is: What are you, who are some of the most distinguished people in the educational field with positions of power and prestige, doing directly, or through your university to try and reverse the role reversal that the Federal Government has taken in the last year or year and a half?

Dr. **Rosenberg.** Well, we are appearing at the hearing.

Mr. **Ertel.** You are here because we are here. We set up this hearing and we appreciate your being here. But beyond this?

I think it is incumbent upon you. We are your representatives and it is incumbent upon you to try and fortify, if you believe the statements we made, to fortify us and to try and reverse that rule. And I hope that you will be able to give me some enlightenment on where you are going to go so we can cooperate, because I think there has to be cooperation at this point between the Congress, the academic community, and the industrial community. The industrial community has just as much at stake and frankly, so does the entire population of the United States.

I want to know what kind of cooperation we are going to be getting from you? And what you are doing, if anything, to bring that about?

Dr. **Rosenberg.** Our university does maintain liaison with the Congress throughout the year. We have a special annual feature today which will come this year, I think, on April 1. This is our day when representatives at the university go to Washington and meet with the entire Pennsylvania congressional delegation.

But that simply highlights the activities that we have in our liaison throughout the year and we do try to bring our concerns to the attention of Congress, to its committees, and staff on a regular basis.

Dr. **Berg.** Congressman Ertel, I think your point is well taken. I can recite a small litany of things. Frank Press at the National Academy is working to bring an awareness of this. Our activities with the technical societies and industrial community appearances but I think you make a good point; namely, organized action on our part is really needed, that which we have not given. So I welcome your suggestion.

Mr. **Schreiber**. Duquesne Univerity has a government affairs office and Mr. Gene Marianni has been in contact with Congress, with the State legislature, and we have, particularly with respect to financial aids, talked to students to urge them to contact Congress, to have their parents contact their Congressmen to indicate the importance of this part in the partnership that the Federal Government has with universities and people.

Mr. **Ertel**. I would like to thank you very much for your comments.

May I just make one suggestion? I don't mean it critically, but having contact with the Congress is helpful, but not the only answer. It seems to me that the way things work in this country, we still are a democracy and it means that we create and educate the public.

It means that the universities are going to have to educate the overwhelming body of this country so that the entire Congress responds as does the administration.

I think it is incumbent upon you as it is us to try to carry a message to the American public of what is happening. That is one of the reasons for this hearing, of course.

But it seems to me the university has a very good forum to speak out, each one of you, to your student bodies, to their parents, and even beyond that.

I think that we ought to be doing that. Maybe that is one of the answers I was looking for to see what you were doing in outreach, to reeducate.

There are a lot of people, as you quoted George Keyworth, obviously money does not create superior education but, on the other hand, superior education probably does not result without money, especially today.

Thank you very much for your comments.

Thank you, Congressman Walgren.

Mr. **Walgren**. Thank you.

Mr. Shamansky?

Mr. **Shamansky**. Thank you.

Since I am from Ohio I will just say that I want to pick up from what Congressman Ertel said. As we drove in we went through the skyscrapers, the headquarters of probably many Fortune 500 companies. I think many are gathered here in Pittsburgh more than any other city except perhaps New York City.

The education that I am interested in is your carrying this message not to the average person on the street because I think it is a little remote, but to the Duquesne Club, if that is what it is called here in Pittsburgh, to the country clubs that surround your community, are you getting the message to those people who are the only people that this administration will listen to.

Those are your constituents. Those are your people who are on your boards of trustees and your advisory committees. That is the group that I think you have to educate for their own best interest.

I don't see how you can continue to prosper as a community or gain some prosperity if you are drying up.

I can't believe that these people are not educable. They have an orientation which causes them to sort of look away, perhaps, right now, but the facts are there and I think you have a tremendously persuasive case.

Obviously, I am convinced that you do, otherwise I would not be here.

I am also glad that Mr. Ertel mentioned Dr. Keyworth's latest addition to one of his homilies. He is good at homilies these days. I think he has gone from being the President's science adviser to merely being an apologist for the President with regard to science.

This nonsense about the eating thing, it is theoretically possible for a rich man to have malnutrition. It is impossible for a man without any money to have good nutrition, obviously.

It is that kind of shallow preaching that I think is, obviously, inexcusable.

I am just curious at what point your community speaks up about that. Who is going to say to Dr. Keyworth: "Enough of this unvarnished nonsense?"

Dr. Rosenberg. As Dr. Berg said, all of us are members of our scientific associations. The national scientific community I think is becoming more vocal by the week, and certainly by the month, on matters of national science policy.

Our own people are very much a part of the movement of the national associations on behalf of the scientific community.

With respect to the unversities, I think your suggestion was a very good one and I think it is being done because our board people, the people who are traditional supporters of universities are, indeed, important people in the industrial business sector of our community and our country.

I think that they have been educated through their work with the university and I think that they understand, but I agree with you that we have more to do.

Mr. Shamansky. I would like to ask Dr. Berg specifically: 50 percent of your students are in science; is that correct?

Dr. Rosenberg. In our liberal arts college almost 50 percent are science majors.

Mr. Shamansky. I am appalled at the comparisons between the Soviet Union and Japan and Germany. The question is not how many do they have. The question is do we have enough?

In the opinion of the panel do we have enough scientists and engineers coming along?

Dr. Rosenberg. I think we have a more serious problem at the graduate student level than at the undergraduate. That was the point I was trying to make.

Mr. Shamansky. But when you say a more serious problem, does that mean that it is not a problem at the undergraduate level?

Dr. Rosenberg. Well, I think there may be problems in certain areas and the point of my remark is that I hate to take the opportunity away from students who would like to major in history or in anthropology or in Greek literature.

I think these are important things also and there are other sectors in our society as well.

Mr. Shamansky. I hasten to discomment. I am completely with a liberal arts background. It is not that I don't appreciate the importance of science, but it is not a neglect.

Any other comments?

Dr. **Rosenberg**. Perhaps my colleagues would like to speak.

Dr. **Berg**. I wanted to make a few comments, first with regard to Dr. Keyworth. Frank Press did hold a meeting at the National Academy, in late October as I recall, in which the science community, I think, laid it on the line to Keyworth and I think he has gotten the message. The impression that many in the science and engineering community have is that he is hopefully talking one way publicly and another way within the administration. There is a feeling that if he did not talk publicly the way he is that he would not be there in the administration. So the feeling is that he is trying to be as supportive of the scientific community as he can be.

Mr. **Shamansky**. Dr. Berg, what happens if his private remarks are consistent with his public remarks?

Dr. **Berg**. Then I think we are really in trouble.

Mr. **Shamansky**. I think we are in trouble. I just wanted to tell you I think you are in trouble.

Dr. **Berg**. Well, I think we are in trouble, in any case, if he means what he says, we are even more in trouble.

Mr. **Shamansky**. Well, this administration has an almost unblemished record of appointing foxes to look after henhouses whether it be on the Civil Rights Commission or the Environmental Protection Agency or the Department of Justice. That is what you are dealing with.

It is not an exception. It is the rule.

Dr. **Berg**. I think it has been remarked before. The thing that many of us find I guess inconsistent is that the goals stated by the administration, namely increase defense, productivity, reindustrialization, all require a strong research science and technology background. It is a sad inconsistency that many of us are having trouble with.

Mr. **Shamansky**. My last question will be to inquire of you or to comment first and ask for your observation.

This administration seems to, when in doubt, say that the market will take care of everything.

With respect to the market taking care of the production of high quality scientists and engineers in sufficient quantity, do you think the market is going to do it as we need it, as time goes by, without a policy?

Dr. **Rosenberg**. Well, our market has been very faulty in many areas of our society. Our market has not taken care of our housing shortages. Our market has not completely taken care of our need for security in retirement. And I think that in the long run perhaps the market will do these things but we cannot wait for the long run.

Mr. **Shamansky**. In the long run we are all dead. I think the line is.

Dr. **Rosenberg**. I think we do have to have more centralized concern and planning for the short range as well as for the long range.

Mr. **Schreiber**. I think it is important to keep in mind the long leadtime that is necessary to train an outstanding scientist. And by the time the market forces will operate—in other words, that there is such a great shortage of scientists and engineers that students will flock into it—there will be a long span when we are going to be exceedingly vulnerable.

The other question that I would like to comment on is your previous one relating to undergraduates. One of the problems with looking at numbers is that very often you may have enough people in the undergraduate programs but the question is where do they go when they graduate. And when you are looking in terms of the science students that are graduating with a science degree today, many of them are going into medicine, into dentistry, into law, increasingly, and they do not stay in the sciences.[1]

However, this is what Dean Rosenberg was referring to. There are not enough staying in the sciences and going on to graduate work.

This is particularly a problem in terms of our very best talents that can make the breakthroughs of tomorrow.

Mr. **Shamansky**. I hope you will get these messages to the board members in Pittsburgh because those are the people who are going to get the message to the administration; otherwise it is a lost cause.

Thank you, Mr. Chairman.

Mr. **Walgren**. Thank you very much, Mr. Shamansky.

The Chair recognizes counsel for the minority, Mr. Rheem.

Mr. **Rheem**. Thank you, Mr. Chairman.

In the interest of time, which is partly my fault because I was in the back seat giving directions trying to get here, I would like to put on the record that the administration's stand for research and development is a strong one.

We know that it is estimated to be an increase of $4.2 billion and the increase for basic research is about half of that.

The question I would like to ask the panel, however, is a question that the ranking minority member of this subcommittee, Margaret Heckler from Massachusetts, is always interested in, and that is what is the role of women in this engineering shortfall?

We know from past hearings and hearings that she and the chairman held in Massachusetts that the number of Ph. D.'s in engineering is about 1 percent women.

Whenever we consider plans or scenarios to increase the availability of engineering personnel, one obvious place is to turn is women and, of course, other minority groups.

What are your universities doing in this regard? How many women are on your faculty and what can the National Science Foundation do to best hit this area?

Dr. **Rosenberg**. We have an increasing percentage of women students in our engineering school. I am sorry that I don't know the exact figure, but it seems to me that the current enrollment is close to 25 percent women.

But women, as you say, have come late to the profession, so they have not yet worked their way into positions of faculty and we are very short.

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[1] Let me hasten to say that it is good that students with science backgrounds go into law and other nonscience professions.

We have very little representation of women on our engineering faculty and I think we are at the level of 1 or 2 percent at that level.

I think that if the trend continues of encouraging women at the undergraduate level in engineering to study, as they move up into the level of advanced training, experience and education that would qualify them, they certainly will be very welcome members of the faculties of all American engineering schools.

We have larger percentages of women among biology students than among chemistry students or physics students, but we have large numbers of women students who are studying computer science and mathematics.

There seem to be patterns of interest of women. I think that it is mostly that. Women are attracted to certain fields at least up until this point.

But I am pleased that they are interesting themselves around many available choices of our curriculum to a greater extent than was true 30 years ago.

Dr. **Berg**. I would like to make a few additional comments about our own particular university. At Carnegie-Mellon, I think there are approximately 30 percent women in the undergraduate engineering school, a tremendous increase over the last decade or so. But here is a case where the marketplace is working to cause women not to go on to graduate school in engineering, to get the Ph. D.'s often required to teach in the university. What happens is that they are graduating. Their salaries are actually in many cases much better than the salary given an equivalent male applicant; so they have gone out to industry. They are not going on to graduate schools. So the number of women in graduate school in engineering is much less than you would expect. That makes it a very difficult thing to fill the pipeline, even in spite of the tremendous demand for engineering faculty today. So the marketplace is working but it is working to counteract some things which might be societally desirable.

Mr. **Rheem**. Thank you.

Mr. **Schreiber**. We don't have an engineering school, so I can't comment on that.

But I mentioned that in our chemistry graduate program we are about 50-50, male-female. But the interesting part is that a large percentage of the females stop at the master's level and, again, because they can obtain rather easily an industrial position at that level and don't see the need of going on.

Mr. **Rheem**. Thank you, Mr. Chairman.

Mr. **Walgren**. Thank you, Mr. Rheem.

Well, I want to express my appreciation on behalf of the committee for your time and views. Thank you very much for joining us.

The next panel represents various industrial perspectives.

Jonathan Green, president of Green International, joined by George Moore, director of education and training for Westinghouse Education Center, and Alex Procyk, vice president of engineering for Dravo Corp.

Gentlemen, we are very pleased that you would give the committee your time. I apologize for the lateness of the hour but we are interested in your comments and your views and any written statement that you would like to make will be made a part of the record automatically.

Please give us your views that you feel you would like to give. Can we start in the same order as the witness list and that would be Mr. Green first.

[A biographical sketch of Mr. Green follows:]

JONATHAN A. GREEN, AIP

President

EDUCATION:

University of Pittsburgh, Graduate School of Public and International Affairs - Master of Urban Planning, 1974

John Hopkins University - Bachelor of Science in Economics, with studies in Engineering and Mathematical Systems, 1966

REGISTRATION:

American Institute of Planners - 1976
American Institute of Certified Planners - 1978

MEMBERSHIP:

American Institute of Planners
American Society of Civil Engineers
American Consulting Engineers Council
Consulting Engineers Council of Pennsylvania
Engineers' Society of Western Pennsylvania
North American Society of Corporate Planners - Board of Directors
Economic Club of Pittsburgh

EXPERIENCE:

1963 to Present

GREEN INTERNATIONAL, INC., Sewickley, Pennsylvania

Since 1976, as Chief Executive Officer and President of Green International, Inc. and its affiliated subordinate companies, Mr. Green has lead a company employing approximately 200 professionals in all phases of engineering, planning and construction.

During and before college, three summers were spent in the field with the survey corps doing highway alignment, cross sections, and ground controls. Several summers were spent in the drafting room working on the design of highways, sanitary engineering projects, and economic feasibility studies. One year was spent as team leader on a project having to do with devising a master plan for a 30-mile long corridor leading east from Pittsburgh. Zones and codes for development were established to control suburban sprawl.

After more than ten (10) years of experience in all phases of planning, engineering, and construction, Mr. Green became successively Vice President/Administration, Vice President/Finance, Executive Vice President and President. During these years he reorganized and directed several offices in the United States and negotiated a number of joint ventures in Africa and South America. He also founded the current Planning Department of the company.

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SPECIFIC PROJECTS:

Principal-In-Charge of Comprehensive Water Quality Management Plan/208 Plan for Pennsylvania Areas 8 and 9.

Co-author of "Study of Decision-Making In The Power Plan Permitting Process In Appalachia." Also, Principal-In-Charge of the study that was the basis of the report.

Principal-In-Charge of Philippine Islands Road Feasibility Study performed for Ministry of Public Highways, Republic of the Philippines.

Provided the Planning systems and Economic input for three comprehensive studies in the environmental field for the County Commissioners of Allegheny County. This area has a population of 1-1/2 million and their needs are projected to the year 2000. These projects were:

a. Comprehensive Water Systems Needs Plan, 1972
b. Solid Waste Management Plan, 1971
c. Comprehensive Sewage Needs Plan, 1970

Principal-In-Charge in the development of a plan to revive the once flourishing harbor and city of Beverly, Massachusetts. Investigations were made of the structural conditions of the docks, pliers, tourist pavillions, and dock-side restaurants. Water and sewage problems were analyzed and new traffic patterns were studied. A report was submitted containing recommendations for phased investment and construction.

Principal-In-Charge of a study financed by the Energy Research and Development Administration to investigate the impact of state and federal regulations upon the coal industry. The final report, "Increasing Coal Production Through Regulatory Integration, 1976", has served as a take-off point for efforts by the current federal administration to address a serious potential constraint upon the nation's energy plan.

Principal-In-Charge of the Environmental Assessment phase of the International Trade and Cultural Center (Interama) project. This was a very ambitious project for southern Florida (over $1,000,000,000) to make Miami the focal point for trade with Latin America. Also assisted in developing the scope and direction of the effort,

Developed and implemented a Management Information System for Green Consulting Service Companies (1971).

Coordinated the preparation of the following studies:

- Sewage Assessment Rate and Sewage Service Charge Studies, Camden, Maine
- Sewage Feasibility Study, Kiskiminetas Valley, Pennsylvania
- Central Garage Study for Central Services Office, Anne Arundel County, Maryland
- Design Report for the King's Point, Manhasset, Long Island, New York Sewage System
- Comprehensive Road and Bridge Study for Moon Township, Pennsylvania
- Billerica, Massachusetts Master Drainage Report and Feasibility Study
- Saw Mill Run, Allegheny County, Pennsylvania Combined Sewer Overflow Study

STATEMENTS OF JONATHAN GREEN, PRESIDENT, GREEN INTERNATIONAL; GEORGE E. MOORE, DIRECTOR OF EDUCATION AND TRAINING, WESTINGHOUSE EDUCATION CENTER; AND ALEX PROCYK, VICE PRESIDENT, ENGINEERING, DRAVO CORP.

Mr. **Green**. Thank you, Congressman Walgren.

I am glad that the questions opened up both at the beginning of the last set of the presentations and at the end of the question periods because the questions that we are facing with regard to human capital are wide ranging.

They have to do with attitudes of society with regard to technology, and education, and with regard to the major choices that confront society as to where we should invest our resources.

Green International takes the graduates from the universities and puts them to work at a very fundamental level. We ask those individuals to produce the buildings that will house industrial processes, the roads to get the products to market and get people to their jobs; to provide the bridges to get them across the rivers and to the university to study; to provide the sewage treatment plants that protect our health and basic physical safety; to provide the airports for people to travel from and places for the planes, both military and private, to land; to produce the ports to provide for the exports of products for this country; and to produce the powerplants, water systems, sewage collection systems, and the like.

These are near to the end of the consumption process. The industrial plants produce a lot of the final consumption—the theaters, the schools, the hotels, the lakes and streams of our society are the final destination of the users of what we provide—but it is close to the final use in our society.

We can't find enough good people.

That is the result of years and years of undercapitalizing our investment in people.

We are looking for bridge engineers and structural engineers at a time characterized by a great recession in the economy and we still have difficulty finding people, people who are of top quality to provide good products for industry and for government.

What is the effect of this shortage? The effect of this shortage is to raise the price of all those goods that we produce.

The engineer accounts for 5 to 10 percent of the total cost of a product, either an infrastructure product or an actual production product. Manufacturing or construction accounts for 95 percent. If you don't have enough good engineers, that 95-percent cost goes up.

Good engineers produce good designs. Good engineers produce good products. If the design phase is not satisfactory, the cost of everything we do and use goes up. The scarce resources—energy, labor and materials—are not used as efficiently and as wisely as they could be.

Engineering is a big tail and it wags a big dog.

The problem of getting enough engineers and scientists into our part of the private economy is not one that can be solved shortly. Oftentimes we get a job that has a very short deadline and from my position as chief executive I will exhort the engineering professional staff to get the job done a little more quickly. They always remind me of the fact that to produce a baby takes 9 months; if you put two women on it, it is not going to be done any quicker.

The same is true with our investments in human capital.

Fundamentally the national investment philosophy that is represented by the current administration is a faulty one for this country. It is just wrong.

Today, in this country, we are short of invested funds for industry. Congress made a big step forward in the last Tax Act in encouraging industry to invest in necessary industrial infrastructure. It was an important step.

On the other hand, we cut back our investments—as a portion of Government expenditures—in the infrastructure provided by the public economy which is necessary for industry to function.

We have cut back, relatively speaking, our investment in transportation which is necessary to get people to their jobs, people to their schools and goods to market.

We have cut back our investment in water systems. Water systems are deteriorating just as the railroads deteriorated. We can ignore it for 10 or 15 years. We have ignored it for close to 10 years now and eventually we will pay a price in our industrial productivity, in our public health, and in higher costs for systems which if they had been adequately maintained, should not require such extensive replacement.

I don't have an easy answer. There is no easy answer. I think Congress is as much responsible as the administration. The last tax bill had some good features in it, especially with regard to encouraging industrial investment which does encourage getting people into engineering education. The market will respond to shortages with higher salaries, and students will look toward engineering careers because they know they can get a job.

But the timelags were significant and the problem won't be solved quickly.

Unfortunately, the Congress also adopted a policy in the last tax bill of giving away a great deal of tax relief; and, therefore, there is no way to find enough money for investment without taking that money and those resources from something, and the only place it can be taken from is either the military budget or from consumption.

By playing the game that we played between our legislative and executive sections of Government, we have essentially condemned ourselves to a situation where the public will not tolerate additional expense and yet we all agree expense is needed in many areas.

On this basis we are not going to solve the problem. It is a fundamental investment question, and yet you have got to invest in the human resources.

I think that what you are saying is sound. I think that a lot of investment that is being made under current budget policies is not as wise as it should be. I think that one has to look at individual programs.

I think you are on the right track in the programs that you are looking at. I think that your proposed bill is a sound step.

I think that the smaller funded portion is the soundest of the steps because I think strategies are needed that are new strategies.

I think there must be sound plans before we spend money. I don't think we can just throw money at the problem and expect ourselves to be rid of the difficulties. I don't expect us to be rid of the fundamental difficulty which is that the people of this country feel we have been throwing money at problems rather than aiming with an intelligent, sensible kind of plan.

Everybody is working very hard at solving the problems within the program constraints that they have. Those people are not loafing at the switch, but they may be working at the wrong problem or in the wrong way.

We have to accept the criticism of prior policies not always being as effective as they might have been.

So I very heartily endorse the concept of establishing a coordinating and planning mechanism.

I think we have got to develop new ideas. This is a typical creative idea, for instance, which has been mentioned but which has received very little serious attention. It addresses some of the problems I described that we face in my company. It has very strong export potential for the United States and very strong training potential for the United States. It merely involves using of organizations like the Peace Corps to encourage the training and the experience of professionals in working not just here but working abroad.

It is impossible to find enough engineers to fill the positions abroad. I think my colleague from Westinghouse can talk to that point even more than I.

Engineers tend to specify products with which they are familiar. We hire British, French, German, and Dutch engineers to fill the majority of the positions we have abroad—in the Philippines, in Colombia, and elsewhere.

These individuals will tend to specify products that they are familiar with, French products, German products, British products.

Let's use the Peace Corps. People like the Peace Corps. It gets people oriented to living in another society and solving problems in a slightly different way. Let's encourage young engineers and technicians to participate in that kind of program. It is a good step. We should enhance that kind of activity, and it is a small program.

There are a lot of small programs that might make some sense. Somehow or another we are going to have to find the method politically to keep small programs small when they should be small, constantly discovering new creative small initiatives that seem to offer some promise and, more importantly, we are going to have to continue to fight to get the American people to recognize that they must forgo a little bit now to invest in this long-term necessary area of human development.

So I thank you very much.

[The prepared statement of Mr. Green follows:]

Testimony of Jonathan A. Green

TO: Subcommittee on Science, Research and Technology
The Committee on Science and Technology
U. S. House of Representatives

DATE: February 11, 1982

SUBJECT: National Engineering and Science Manpower Act of 1982 HR5254 and Proposed Spending for Federal Programs and Support of Science of Engineering Education

Gentlemen:

My name is Jonathan Green and I am President of Green International, Inc., headquartered in Pittsburgh, Pennsylvania with offices in Boston; West Virginia; Ohio; Bogota, Colombia; and Manila, Philippines. Our firm is a broad-based Engineering, Architectural and Planning Consulting Firm serving both industry and government. The types of projects which we plan and design include:

- industrial structures,
- highways,
- bridges,
- airports,
- ports,
- commercial buildings,
- educational buildings,
- environmental systems,
- sewage and water treatment plants,
- solid waste management systems,
- irrigation systems,
- water supply systems, and
- small hydro-electric power systems.

The disciplines that are required for this work include:

- civil engineering, both structural and sanitary,
- electrical engineering,
- mechanical engineering,
- geotechnical engineering,
- architecture,
- urban and regional planning, and
- a number of basic sciences such as chemistry, geology, and biology.

The professionals and support personnel who are permanent employees of the firm number approximately 200. These individuals are supplemented by consultants, temporary employees, and other support and technical personnel at a nonprofessional level.

As can be seen from the listing of the types of projects in which Green International participates, the firm is involved both in developing (1) the actual capital structure and infrastructure needed by industry to produce its products, and also (2) the basic public infrastructure necessary to support the consumers and producers of those products. These services are provided both in the continental United States, as well as overseas. The consulting industry which I represent is characterized by approximately 70 medium-size businesses which fall just around the cutoff point for small business administration support (sales of 7.5 million per year); a much smaller number of large firms; and the vast majority of firms in the field which contain less than 100 people and survive by serving a limited set of specific, tightly-defined technical and professional requirements of industry or government. It is to this professional consulting community that the world looks, and certainly the nation looks, to design the water supply systems, the sewage treatment systems, the solid waste disposal systems, the industrial parks, the new communities, the irrigation systems and the like, which go to support the basic activities of both production and consumption in the United States.

The Source and Scope of the Shortage

The personnel who make up our firm, and firms like us, generally exceed the average age of the population. The reason for this is that the number of young people being trained by our colleges and universities does not match the requirements of the industry for qualified personnel. In the past, many of the individuals who became qualified in the engineering disciplines did so through a long period of apprenticeship, beginning as draftsmen or junior technicians, rising after many years of experience into very specialized positions with strong abilities to perform specific technical and professional tasks. Given the increasing complexity of the technical disciplines, this apprenticeship approach is no longer sufficient to produce adequate quantities of professionals to supplement those produced through the university system. This accounts for the older average age in the profession today.

Although a large proportion of the requirements in the technical disciplines are being met through increased use of computers, for the foreseeable future, automation will not relieve the current shortage of top-quality people. In fact, the current trends toward automation will, by reducing opportunities for the lesser trained professionals and the support technicians, further choke off the traditional apprenticeship avenue for development of professional expertise involving the evolution from subprofessional to professional work through on-the-job experience. In particular, the avenue of moving from draftsman to design engineer is likely to be eliminated in the next several years as the drafting operation becomes almost totally automated through computer-aided drafting.

Additionally, the increased automation and complexity of the engineering disciplines imposes a demand for better trained, more knowledgeable professionals who will be capable of utilizing the tools being developed by the systems and automation industries.

I would like to describe our current difficulties in obtaining trained technical personnel. It is important to realize that these difficulties exist in the midst of a very serious recession. The recession has been described as the deepest recession since the great depression. Unemployment in Pennsylvania is now over 11 percent, and this unemployment very much affects the capital goods industries. Thus at a time when industry is investing very cautiously and modestly, any difficulty in recruiting trained people is of particular significance. Once the economy regains its normal strength and the investment program sponsored and encouraged by recent actions of Congress begins to take hold, the shortage of engineers will move from the acute stage to the impossible.

In the preceding months, we have advertised for structural engineers. We have been looking both for structural engineers capable of designing industrial buildings and structural engineers capable of designing bridges. As a result of our efforts, we have received inquiries from only two qualified candidates in over a month of looking. Meanwhile, we have four additional positions to fill. This week ads will appear in the Cleveland and Columbus newspapers in the hope that we can obtain high quality structural engineering personnel from these markets which are also depressed. However, our experience in Pittsburgh, a market that contains probably more structural engineers than any in the world outside of New York, leads us to have little confidence that this approach will be successful.

What are the Stakes Involved?

A major factor which must be considered as part of the background against which the current shortage of high quality technical personnel must be examined is the increasing costs of construction around the world. We are all aware of the effects of inflation in our everyday lives. What may not be quite so apparent is the fact that, in the last ten years, increases in the construction industry have been approximately twice the average increase in cost for other goods and services being purchased in the market place. As the cost of construction goes up, reflecting an increasingly short supply of the raw materials of construction, it becomes even more crucial that the design professional organize and plan for the use of these scarce materials in the most efficient way possible. Good design results in efficient construction. Poor design results, not only in wasted use of materials initially, but also long-term higher costs of energy, labor, and materials as these facilities are operated.

A second consideration is the impact of this shortage of qualified, trained people on the United States' balance of payments and its export position. The vast majority of basic infrastructure required in the United States has been built in the last 35 years and is largely adequate - given proper maintenance - into the future. (Yes, certainly we will have to modernize our railroad system; yes, certainly we will have to rebuild our water systems; we will have to expand our pollution abatement sewage systems; and the like. But our highway network, our water network, and our port systems are highly developed as is a large proportion of our heavy industrial capabilities. In the United States, we are talking about a maximum ten percent expansion in these systems per year in order to enhance our capabilities and quality of life and to replace worn-out or outmoded systems.) Other parts of the world are not so fortunate. The vast majority of countries in the world often lack even the rudiments of the basic infrastructure which we have in the developed countries. These nations are growing at a rapid rate and have an enormous demand for the same kinds of transport, environmental, and industrial infrastructure which we take for granted in the United States. All of these facilities will have to be designed. All of these facilities will place demands upon the supply of goods which are available in the world for their completion. They will affect the price of goods in the United States that are employed for similar uses. More importantly, much of the necessary supplies and equipment can be obtained from the United States - or they can be obtained elsewhere.

Green International is involved in a modest way in the International Engineering and Construction arena. Increasingly, the actual positions to be filled on our overseas staff are being filled by professionals from England, Europe, and Japan. The reason for this is our inability to find sufficient numbers of well-trained professionals in the United States who are willing to work overseas. This is one measure of the short supply of professionals in the engineering, architectural, and planning disciplines. It is important to note that although this work represents only five to eight percent of our current sales, it produces 20 percent of our annual profits. Far more important from a balance of payments standpoint, is the fact that engineers tend to specify products with which they are familiar and comfortable: products in which they have confidence that the required performance will be forthcoming. Thus, American-trained engineers tend to specify American methods and American products. The same is true of European engineers, Japanese engineers, and the like. Every job filled by an American design professional produces a far larger number of jobs back home in producing the cement, the reinforcing, the machinery, the piping, and the electrical components that are required for the construction and operation of the designed system.

What will be the direct result of this shortage on projects in the United States? Well, let us consider what will happen when the demand for capital replacement regains its momentum after this recession. The result will be that engineering firms will be unable to provide the highest caliber of professional personnel to design the plants, the foundations, the highways and the bridges, not to mention the sewage treatment plants and the power stations that are required as part of the normal expansion and continuation of our highly technical society. Technically-skilled individuals will be spread thin and the efficiency of design will decline. It must be remembered that engineering accounts for approximately five percent of the ultimate cost of a new facility. Ninty-five percent of the cost is required for construction. This requirement involves skilled labor; it involves materials, such as cement, wood, steel, and the like, as well as construction equipment and fuel. A less efficient design will mean that the cost of all these goods will be higher than it need be. These costs will be passed on to a whole generation of consumers. We will be less efficient at home; we will be less efficient in our ability to compete against products abroad.

On the foreign front, the increasing demand for engineers at home will make it even more difficult to staff overseas assignments with American personnel. The opportunities to export American construction materials and American machinery will be lost. This loss will also reflect a long-term reduction in the usage of American parts for replacement of worn-out equipment.

For all of these reasons, I urge the Congress to give consideration to House Bill 5254 and to the funding of technical education for young people.

It could be argued, I recognize, that by increasing the salaries of engineers, we automatically will attract young people into the labor force in these areas. This is true. But it is only true in the longest of runs; the lag between the recognition of a technical career as a highly desirable future for a young person and the development of that young person into a top quality professional is approximately 20 years. Yes, the current and future shortage will raise the price of engineers, it will raise the price of engineering, it will raise the price of everything. But it will be 20 years before we can expect that young people will have responded to this situation, made the sacrifices required by a technical education, and provided significant contributions in these fields. For those 20 years we will have missed an opportunity and we will have found ourselves in short supply of the basic bread-and-butter personnel required by every physical system underlying our economy and ultimately our standard of living.

Thank you.

Mr. WALGREN. Thank you very much, Mr. Green.

Mr. Moore, director of education and training at Westinghouse.

[A biographical sketch of Mr. Moore follows:]

BIOGRAPHICAL RESUME

GEORGE E. MOORE

EDUCATION:	University of Pittsburgh	B.S. Electrical Engineering	1943
	Harvard/M.I.T.	Officers Advanced Electronics Training	1943-44
	University of Pittsburgh	M.S., Electrical Engineering	1952
	Harvard University	Program for Management Dev.	1962

EXPERIENCE: Current: (1969-1981)

(a) Director, Education Department, Westinghouse Electric Corp. - Responsible for the recruiting, selection and hiring of 800 new college graduates/yr.; managing the early training and placement of 250 new graduates; providing management and professional development courses for some 7000-8000 Westinghouse employees annually; maintaining university relations with some 300 colleges and universities.

(b) Executive Director, Westinghouse Educational Foundation - Administration and development of a college support program that distributes $1.25 million in grants each year.

(c) President, Westinghouse International Educational Foundation - This foundation was created in 1980 to provide support for engineering colleges/universities overseas.

1962 - 1969 Vice President for Development and Public Relations, Polytechnic Institute of Brooklyn - Reported direct to the President and had broad responsibility for fund raising, public relations, and continuing engineering courses for industrial affiliates.

1952 - 1962 Westinghouse Electric Corporation - Manager, University Relations and subsequently Manager, Graduate Student Training. These positions involved the training and placement of some 600 new graduates each year and the development and management of relations with some 300 universities.

1948 - 1962 Assistant Professor, Electrical Engineering Faculty, University of Pittsburgh; Director of Graduate Engineering Studies.

1947 - 1948 Research Engineer, Electronics Research Laboratory, University of Pittsburgh.

1943 - 1948 U.S. Army; Highest Rank, 1st Lt. Artillery.

Other: Senior Member IEEE; former Chairman National Education Committee. Engineering Manpower Commission, former National Chairman. Recipient Westinghouse Order of Merit, highest honor given by Corporation. First Presbyterial Church of Pittsburgh - Elder for 7 years and former President of Board of Trustees. Member of American Society of Engineering Education. Former Chairman of the Continuing Education Section.

1981 - Distinguished Engineering Alumni Award, University of Pittsburgh

STATEMENT OF GEORGE E. MOORE

Mr. **Moore**. Thank you, Congressman Walgren, Congressman Ertel, and Congressman Shamansky. Thank you for the invitation. I am delighted to be here.

I am with the Westinghouse Electric Corp. I have spent the bulk of my career there and I have been, over the years, closely involved with the technical, and personnel side of our business.

I would like to amplify the written remarks I earlier provided and in so doing illustrate our corporate concerns and our interaction with the colleges and universities where I believe, we can all agree that attention needs to be directed.

First, I am responsible for staffing the Westinghouse Electric Corp. with college graduates, new, young people.

If I target 1981 specifically, we hired 899. These were principally engineering graduates.

In order to accomplish that task, we interviewed about 12,000 seniors at 180 institutions. If I put that in another context, this represents about 20 percent of all of the graduating engineers produced by this Nation's colleges and universities last year.

Interestingly about 23 colleges and universities, historically, have provided about 45 percent of our talent year in and year out.

Between our company and about 180 colleges that we concentrate on, there is lots of interaction.

We have representatives that are identified to work closely with schools, and the faculty, to understand the problems.

There is lots of interaction on many levels: Students being employed for the summer, faculties employed for the summer, technical speakers from Westinghouse speaking at symposia at colleges and universities.

In fact, I might say, Mr. Shamansky, that our chief executive officer serves as the chairman of the board of trustees here at the University of Pittsburgh. Also our vice chairman serves on the board of trustees of Carnegie-Mellon. They are very much aware of the problems that I think you want to see voiced in the board rooms and in the Duquesne Club.

Let me, Mr. Rheem, make a comment I think that relates to your question.

Twenty percent of the 900 young people we hired in 1981 were young women. That is 180. Largely with degrees in engineering and to a smaller degree in the physical sciences.

Thirty-five percent of this 900 were women, minorities, blacks, chicanos, Spanish-speaking, or Asiatic-Americans.

In recruiting people, we all try to target those whom we feel are the best. We target our young graduates out of the top half of the graduating class. And I guess one of my greatest concerns is that I wish the top half contained 75 percent of the graduates rather than 50.

If we could force the mathematics to get that to happen, it would be great.

Nevertheless, we have to do a lot of supplementary training with many of our young, new engineering graduates concerning state-of-the-art problems utilizing equipment that they are not familiar with so as to bring them to a point of early productivity.

This situation has tended to increase over the last 5 to 10 years where technology has been changing at an ever-increasing speed, much more so than it did in the two or three decades that preceded the 1970's.

Now, there is another area where I have responsibility, namely, training within the corporation.

We have, in Westinghouse, about 36,000 managers and professionals. Professionals comprise about 23,000, and managers 13,000 out of a total employment of 140,000 people.

I advised that we hire 900 new graduates in 1981, this is a little over 2 percent of 36,000. It sounds like a great number of people, but actually it is not large when looked at in this light.

These people bring to us technology transfer. They are our life's blood. We are a company that, by and large, sells capital equipment and it is highly technical in its nature.

To stay in the forefront of technology, we must continue to hire on a regular basis top flight people from top flight universities.

Now, one problem over an engineer's career, and I suspect it's a problem we all face in our careers, is the constant race between obsolescence and retirement.

Accordingly, we invest a tremendous amount of money and effort in making sure that this human resource stays current and does not waste away.

I am very involved with providing corporate training to our 36,000 managers and professionals. In any one year, we will have in our symposia and workshops and courses, 10,000 students. By and large they are in the classroom for concentrated periods of a week. Our subject matter ranges from very technical finite element analysis to not so technical techniques of marketing, selling, and presentation skills.

I will mention a third area of corporate/university relations, namely, the Westinghouse Educational Foundation. The foundation has been in existence since 1944. It was created primarily to financially support colleges and universities recognizing that it is from such sources that we get our professional talent. Westinghouse has felt a long and continuing obligation to invest in its sources of talent. These support programs, by virtue of the foundation's charter, are heavily oriented to engineering education. We do not support a broad spectrum of colleges simply because our resources are limited and our interests focussed.

A key program is the Westinghouse science-talent search. This program targets young people in high schools and tries to encourage them to pursue careers in science and engineering. In fact, you may have recently read that the Westinghouse science-talent search has to date produced its fifth Nobel laureate. It is a magnificent program. It is the longest running program of its kind in the country. It dates from about 1942.

We also, in the foundation, support specific grants to colleges and universities. One of the most recent is at the University of Pittsburgh, a grant of $400,000 that is aimed at updating and strengthening the engineering school's capability in the area of microprocessors, interactive graphics, CAD/CAM, computers on chips and the like. If such material is not in today's engineering curriculum, the program is just not up to date.

Similar grants have been made to Carnegie-Mellon, Duquesne University, and year in and year out to about 100 universities across this country. We assist universities in staying updated and encourage them to tell us what they need rather than us trying to direct them in what they should do. Incidentally, I am delighted with the program you have proposed as I believe that it supplements our foundation's efforts. Our focus is on getting engineering curriculums updated and programmatically supporting faculties and students to that end. We have not had money to put into hardware and instrumentation. Nor have we funded many fellowships. Largely we are trying to focus on the curriculum and buy time for the faculty to redevelop both courses and themselves.

One final thing, about 20 percent of our foundation's resources over the last 5 years have been directed toward minority education, trying to help blacks and other minorities obtain engineering degrees, because certainly in Westinghouse and in many of the Fortune 500 companies, there is a very strong technological ingredient that our people need in order to effectively manage the operation. We do not hire managers from colleges and put them in a management program per se. We hire the brightest talent we can find with heavy emphasis on technology. This pool or resource ultimately provides us with our management personnel.

Well, as I said before, I am delighted with what you propose. I think it is very necessary and I do think you will find industry responsive.

[The prepared statement of Mr. Moore follows:]

Westinghouse
Electric Corporation

Education Center

Ardmore Boulevard & Brinton Road
Pittsburgh Pennsylvania 15221

February 9, 1982

Subcommittee on Science, Research and Technology
Of the House Committee on Science and Technology

My testimony to the subcommittee is based on several relevant factors. First, I have responsibilities for recruiting approximately 700 to 900 new college graduates each year for the Westinghouse Electric Corporation (90% of whom are engineering or physical science graduates), and the training of some 10,000 of our managers in state-of-the-art skills and techniques ranging from engineering and technical subjects to marketing and management. In addition, I participate in the review of several hundred requests each year from engineering colleges and universities seeking support from the Westinghouse Educational Foundation. In 1982 some $2,000,000 in grants will be distributed to approximately 100 colleges, universities, and educational associations. Overwhelmingly, these grants are targeted to strengthen engineering education.

Rather than comment on the impact of a reduction in federal programs supporting science and engineering education, I would prefer to comment on the status of engineering education as it has existed in the near past, and its viability in the present and foreseeable future. Stated another way, even at existing levels of support, there are substantive problems that need to be addressed.

From industry's vantage point, the bottom line is the quality and quantity of the graduates produced by our universities. The quality problem stems in part from obsolete Professors and laboratory equipment, neither of which are being updated or replaced in a timely fashion. At the other extreme, highly effective faculty are unwilling to forego the attractive salaries and career opportunities offered by industry. Quality engineering and scientific research require the tools, instrumentation and equipment that industry, but not our colleges, provides.

These observations have not escaped today's engineering graduates. Few are willing to subsidize a full-time graduate education by forsaking earnings of $25,000 a year. Further, a PhD program involving five years of intensive study supported by less than the latest of laboratory equipment has found less and less favor in the eyes of today's graduates.

The quality problem is also complex. While our high technology industries are plagued with shortages of electrical and computer engineers, some 25% of our nation's engineering schools are restricting or reducing freshmen engineering enrollments. The insufficiency of teachers, space and equipment, all related to funding, are cited as the reasons.

The problem is identifiable. The solutions, however, are complex and difficult to achieve. Nevertheless, we need to develop approaches that will (1) re-educate and update existing faculties, (2) provide inducements, i.e., career opportunities, modern tools and equipment, to persuade younger faculty to stay in the teaching profession, and (3) attract the best of our Bachelors graduates to pursue advanced degree studies. Older approaches must give way to new and radical thinking if solutions are to be found.

In summary, the condition of engineering and scientific manpower in our country grows exceedingly critical; however, the focus of our attention needs to be on our engineering schools and our physical science departments. Many of these elements seem to be implicit in legislation introduced by Congressmen Walgren and Fuqua. Westinghouse and I believe industry in general encourages this action.

George E. Moore, Director
Education and Training
WESTINGHOUSE ELECTRIC CORPORATION

Mr. WALGREN. Thank you very much, Mr. Moore, for your testimony. We will be returning to you for questions on your excellent presentation.

The next witness is Mr. Alex Procyk.

Mr. Procyk, I thank you for being with us. We look forward to your testimony. Your written testimony will be incorporated in the record and you may summarize it or do as you please.

[A biographical sketch of Mr. Procyk follows:]

Brief Biographical Sketch
of
ALEX I. PROCYK

1. Alex I. Procyk
V.P. - Engineering
Pittsburgh Operating Center
Dravo Engineers & Constructors
One Oliver Plaza
Pittsburgh, PA 15222

Home Address:
177 Parkedge Road
Greentree, PA 15220

2. • BSME, University of Pittsburgh, 1963
   • Registered Professional Engineer, Pennsylvania
   • Member of following Engineering Societies:
     - ASME (American Society of Mechanical Engineers)
     - AIME (American Institute of Mining, Metallurgical, Petroleum Engineers)
     - ESWP (Engineers Society of Western Pennsylvania)

3. 30 years with Dravo Corporation in various positions and Divisions, initially as Drafter then Designer, then Engineer and then various supervisory and management positions within Engineering from Chief Mechanical Engineer through Chief Design Engineer through current position.

4. 2 years U.S. Army, 1957-59, Transportation Corps.

STATEMENT OF ALEX PROCYK

Mr. **Procyk**. I certainly do not intend to read all of my written testimony, but I will strike the highlights and relate them.

Also, I don't know whether it was by accident or design, but I believe by whatever means this particular panel was selected happened to be a rather good cross section, in my opinion, in that although Mr. Moore of Westinghouse speaks in terms of 12,000 engineers, I believe it was, and his organization, I am with an organization and I speak in terms of 1,500 to 2,000 engineers here in the Pittsburgh office and I think Mr. Green speaks in terms of 200. So there is a good representation here and we all come from a little slightly different perspective.

I first want to address myself to the broad overall question, the impact of the reduction in Federal programs on engineering and engineering education. I might say that when I prepared my written testimony, I had not known at that time what specific fund had been decreased or would be comtemplated to be decreased and so, therefore, not really knowing what order of magnitude in terms of dollars were being considered here, in my written testimony I did not address myself to any form of dollar value. Hearing some of the numbers here today, that would cause me to have slightly different reactions than I had when I prepared the written statement.

At any rate, my particular knowledge of what particular programs have been in existence or are currently in existence are limited primarily because my particular focus of attention as a vice president of engineering of an engineering construction company has been primarily on the application of engineering and technical knowledge instead of focusing on the educational process of those engineers itself.

Of course, I and our corporation experience the results or nonresults, if that may be the case, of the educational process although we ourselves are not in the mainstream of education except as support for that education through such vehicles as tuition reimbursement programs for our individuals that we already have on board or as advisory participants to universities when they ask for industry's thoughts and opinions when they are studying their own curriculum.

Also, in the form of, at least in the case of our company, matching funds programs whereby a corporation matches funds that would be donated by an individual to universities as well as programs on the company's part to give direct grants to some universities.

At any rate, without referring to specific funds I cannot see what the impact of reductions might be. But being an engineeer I am, of course, quite aware of the fundamental importance of maintaining a strong, innovative, and creative level of technology on regional, State, and national levels and the role of the educational institutions in providing the basic education that makes a large part of that technology possible. Therefore, I have a natural tendency to view any form of movement toward reducing funds with a high degree of apprehension, whether it scares the hell out of me or not depends upon how much it is.

I realize, of course, at the same time that there is a limit to the ability of the taxpayer to fund the number of programs that the diverse interests of the country wishes to have, in fact. Unfortunately, it is with a lot of you gentlemen to try to find that balance point among all the diverse needs and wants. We are here speaking today just science and engineering.

What I do know, in my opinion and there is maybe some divergence of opinion here, is that the engineering graduates that have been coming out of the universities, in general have been of high quality and well-educated in the fundamentals of their education's field. I, at times, have been puzzled myself on it because I personally am a believer that the level of education in the secondary schools in the form of science, mathematics, et cetera, et cetera, is very weak and I think that is an understatement. Yet, our experience is that the engineers coming out of the university are of a high quality. Why that should be, I don't know. I don't see specific reasons, but somewhere I came to the conclusion that the universities have been doing a pretty good job starting with what I think is a less than high quality and ending up with a good quality.

Whether that is all due to good funding, good faculty, good direction on the part of the school's administration or certainly also conscientious effort by the students themselves once they get into the university, I don't know.

Whatever the educational system has been doing to make up for this lack in the secondary schools, I believe somebody, somehow has been doing a lot of things fairly well. But, whatever that might be, decreasing or dropping fundings is one of these elements that go into turning out high quality people is bound to have a cascading bad effect. I just don't know how to quantify what that effect might be.

Addressing myself to the shortage or lack of shortage of engineering people, I am confining myself to engineering people as opposed to science. That varies, of course, with the level of business and demand in that particular area as well as any other areas in the country. And I would say, if I just focus upon the current time period, the supply of technical skilled employees and generalists, as I call them in this area, have been rather fair to good over the past 2 years, although I know for an absolute fact that if you were having this hearing right today in Houston, Tex., and if I were there, I am a part of the Houston, Tex., engineering environment, I would be telling you that the shortage is overwhelming. There is a tremendous shortage.

Although I believe that our balance in this particular part of the country in terms of, I'll call them general engineeering, is fairly good, fairly balanced. Nonetheless, as always, there is a shortage of technical skilled employees, engineers with experience. I attach to my written testimony a copy of January 4 issue out of the Pittsburgh Business Journal that addressed itself to the shortage of engineering people in this area. I won't go into it now, but I believe that that article gives a fairly accurate overview of the situation.

If the economy of the United States and this region picks up, if the steel industry were to engage in large scale modernization of facilities, if the effort to develop facilities for synthetic fuels and energy that has been a somewhat on again off again thing in this country were to be turned on again, I would be sitting in front of you just like the people at Houston would today telling you of a greater shortage. However, even without listening to anybody this morning, the major problem is that the education of engineers in universities cannot be turned on and off like a faucet. The course of study consumes 4 to 5 years. It is a minimum of 3 years upon graduation that an engineer begins to contribute to true original design of anything. Therefore, really what we are talking here today about is not the shortage or nonshortage that exists in 1982, but what are the needs and requirements for 1990. What we are sitting here talking about today is something that should have been talked about in 1972. It is the same theme.

When I review back over the past 20 years or so and attempt to smooth out those various peaks and valleys, I invariably come to the conclusion that there is a blended average that historically there has always been a shortage of anywhere in the realm of 10 to 15 percent of engineers.

Currently, and I see no change in this, the shortage in the form of computer people, be they computer applications, computer programmers, seems to be far and above that of most of the other particular types of engineers. Why this is rather persistent with a few exceptions, I don't know. We collectively, be it the Federal Government, States, industries, what have you, really are not doing a very good job.

I perhaps should digress to say that in some manner everybody talks about it and writes about it, but in some manner, collectively, the Europeans, the Japanese, et cetera, have a better means of looking out 10 years ahead as opposed to being preoccupied with what this year's or next year's total profit, total budget, who is doing the most training at the present time. They seem to have a better ability to consistently look 10 years out.

As a part, also, of the feedback that I get nothing of the shortage of people is the reliance that we have on foreign technology.

Quite frankly, the basic technology for various processes that are performed in this country are really held by foreign firms. See, that in itself, although I would say we don't have a shortage in some areas, the fact of the matter is because of the import of foreign technology, that is one of the reasons why, in some cases the shortage isn't as great as it might be otherwise.

I'd like to make a comment also, somewhere in the conversation this morning, the subject of student loans introduced itself. I, myself was not aware of the extent other than the public newspapers about the different formulas to be used on calculating loan rates, et cetera, for student loans, but, whatever means that this particular bill and analysis could exercise, including myself, toward promoting better means of providing student loans for people I, for one, support that considerably.

I have seen too frequently, because of the high cost of education, a lot of individuals be they out on the streets or be they in other jobs or be they people that we have in Pittsburgh at a nonengineer level, who have as much if not more basic, intelligence capability of supplying those needs of being scientists and engineers but who just simply can't afford it or their families can't afford to send them to school.

I believe that rather sums up everything I have except that in the written testimony. I believe that sums up my overview.

[The prepared statement of Mr. Procyk follows:]

Dravo Engineers and Constructors
One Oliver Plaza
Pittsburgh, Pennsylvania 15222
412 566-3344

A Dravo Company

A. J. Procyk
Vice President
Engineering
Pittsburgh Operating Center

February 10, 1982

Congressman Doug Walgren
Chairman
Subcommittee on Science, Research & Technology
U. S. House of Representatives
117 Cannon House Office Building
Washington, D.C. 20515

Subject: National Engineering and Science
Manpower Act of 1982, H.R. 5254

Dear Congressman Walgren:

1. On Friday, February 5 I was requested, through Dravo Corporation, to participate in a panel discussion regarding the subject of engineering and technology education and training, with more particular attention focused upon H.R. 5254.

2. On Monday, February 9 I received a copy of H.R. 5254 along with a letter from your office which described the "panel discussion" as being a hearing at which written testimony was requested.

After recovering from my partial surprise at the conversion from what I had (erroneously) thought was going to be an open, free-wheeling panel discussion to that of a hearing with written testimony, I none-the-less proceeded to read the letter and H.R. 5254.

As a result of this, I have provided, in written form, my thoughts and opinions that were and are within me.

Perhaps I have expressed opinions on matters which are beyond the intent of the hearing; in other cases I may have expressed insufficient opinion or basis for that opinion.

I trust however that my participation, when added to that of so many other participants, will enable your committee and Congress to arrive at a decision that is of greatest overall value.

Dravo

February 10, 1982

Congressman Doug Walgren, Chairman
Subcommittee on Science, Research & Technology
Washington, D.C. 20515

3. My written commentary is attached. It is my own, does not necessarily represent opinions of others nor of Dravo Corporation, whoever that may be. I hope your committee finds it to be of assistance.

Very truly yours,

A. I. Procyk

AIP/smd
attachment

Dravo

COMMENTARY

1. I was asked to participate in this Hearing and give my viewpoints and opinions on three subjects:

   a) "The impact of reductions in federal programs supporting science and engineering education in colleges, universities and industry in the Pittsburgh area"

   b) "The experience of your company in hiring and retaining technically skilled employees"

   c) "The 'National Engineering and Science Manpower Act of 1982', H.R. 5254"

2. Impact of Reductions in Federal Programs

As regards to the subject of impact of reductions in federal programs, I regret to say that my knowledge of what federal programs have been in existence and which are in existence is limited.

This is because my particular focus of attention, as Vice President of Engineering of an engineering-construction company, has been primarily on the working environment and the application of engineering and technical knowledge towards the engineering and construction of industrial facilities instead of focusing upon the education process itself.

I and our corporation experience the results (or non-results) of the educational process but are not in the mainstream of education itself except as support of that education through tuition reimbursement programs for our personnel or as advisory participants to universities (West Virginia and Pennsylvania State Universities) when they have solicited opinions from industry as regards to their curricular studies in their efforts to up-date or improve their own educational process.

Because of the above and because I am not aware of what specific amounts of funds or what specific programs are being reduced, I cannot say what the impact of reductions will be.

Being an engineer, I am quite aware of the fundamental importance of maintaining a strong innovation, creative level of technology on regional, state and national levels and the role of the educational institutions in providing the basic education that makes a large part of that technology possible. Consequently, I have the natural tendency to view reductions in technology programs or reductions in technical education program funding with apprehension.

At the same time, however, there is a limit to the ability of the taxpayer to fund the number of programs that our diverse interests may wish to have.

I do not know where the best balance point is between these twin goals of fostering scientific and technical education but simultaneously at a cost that the taxpayer can afford.

2. Impact of Reductions in Federal Programs (continued)

What I do know is that the engineering graduates that have been coming out of the universities are, in the general case, of high quality and are well educated in the fundamentals of their engineering field. In addition, contrary to a sometimes widespread notion that the work-ethic is not present among today's grads, it is present.

There may have been a time during the late 60's or so when a tendency developed among grads to have more interest in their leisure activities than in their chosen work profession. If such a tendency did exist, such is not the case today, nor for the last five or more years.

The difference that I see today is a large tendency on the part of many engineering graduates to view "engineering" as just a stepping stone to their real goal as "management". There is a tendency on their part to not really want to practice engineering for engineering's sake but only long enough and well enough to become "managers".

They perceive greater prestige and greater financial rewards as managers than as engineers.

And so, if I had to ennunciate a brief conclusion, it would be that the universities are doing a good job at educating engineers in the fundamentals of engineering. Whether this is due to good funding or good faculty or good direction on the part of the school's administration or conscientious effort by the students themselves, I don't know. It is undoubtedly due to the combination, not due to any one or two elements.

Decreasing or dropping funding as one of these elements is bound to have an effect, but how much is indeterminate.

3. Experience in Hiring and Retaining Technically Skilled Employees

As regards to the interest of hearing of our company's experience in hiring and retaining technically skilled employees:

> The ability to hire and retain technically skilled employees varies with the level of business and demand in this local area as well as nationally.

Quite frankly, the supply of technically skilled employees as generalists in this area has been rather fair to good over the past two years or so (I'm sure you would get a vastly different answer if you were to conduct a similar hearing in Houston today or in Pittsburgh eight years ago).

What has been in short supply, as almost always seems to be the case, are technically skilled employees with experience in various specialized technical fields.

The January 4 issue of Pittsburgh Business Journal included an article on this subject. A copy of that article is attached. This article gives a fairly accurate overview of that situation.

I would emphasize, however, that the shortage is in experienced specialists, not across-the-board general technical people. The article does not make that point well enough.

If the economy of the U.S. and this region picks up, if the steel industry were to engage in large-scale modernization of facilities, if the effort on developing facilities for synthetic fuels were to assume a higher priority again, etc., etc., we in the engineering-construction industry would be sitting here in front of you crying out about a gross shortage of technically skilled employees, and you would be hearing from me at least a vastly different story.

This year, however, the supply/demand is approximately in balance, at least from our viewpoint.

The main problem is that the education of engineers in universities cannot be turned on and off like a faucet. The course of study consumes four or five years before a degree is obtained. Then at least three years of experience is needed before the engineer truly is participating in original design. Thus, the demands of 1990 have to be met by individuals who will begin their technical education this year.

Looking back over the past twenty years, my belief is that, on balance, there has been shortages in the engineering professions as follows:

- Civil Engineering - Balanced
- Mechanical - 5 to 10% Shortfall
- Electrical - 10 to 15% Shortfall
- Instrumentation/Controls - 15 to 25% Shortfall
- Computer Applications - 15 to 25% Shortfall
  Engineers and Programmers - (Currently probably about 40% Shortfall)
- Piping/Fluids Systems - 10 to 20% Shortfall
- Chemical Engineers - 10 to 20% Shortfall

It would be interesting to compare this viewpoint with the experiences of the universities who are statistically knowledgeable as regards to the demand for their graduates.

4. Commentary Regarding "National Engineering and Science Manpower Act of 1982", H.R. 5254

I will attempt to address myself to each paragraph within this Act, giving such commentary as entered my mind during the brief time (2 days) that I had between the time I first saw a copy of the Act and this reaction to it.

Sec. 2 (a) Para. (1)

This is a self-evident truth, a fact, and an important one.

Sec. 2 (a) Para. (2)

As I stated in another part of my overall commentary, our particular experience here is Western Pennsylvania over the past two years has been such that, locally, there has not been a pressing need. However, as a reader of nationally-published technical journals and engineering-construction magazines, one has only to look at the large number of ads month after month for experienced technical people to know that, balanced across the entire U.S. there is definitely a shortage of trained, experienced engineers and technicians, and so in my viewpoint this is an accurate assessment and conclusion.

Sec. 2 (a) Para. (3)

I'm unable to comment on this one due to insufficient awareness as to whether there is or isn't a Federal comprehensive policy or committment.

Sec. 2 (a) Para. (4)

Once my own daughter graduated from high school, I ceased to be as conscious of the quality of science/math education at the primary and secondary levels as I once was. My still fresh memory of that time period however coupled with random discussions with neighbors and friends causes me to believe and agree with that statement.

Only now are some of the high schools re-examining their curricular and programs and seemingly are making some efforts to improve their educational roles.

I do believe however that the universities have been maintaining quality educational programs for engineering students and at least in the case of Penn State and West Virginia University, have programs to up-date their curricula by asking industry members to participate with their faculty in doing so by means of providing feedback and commentary to the Schools of Engineering within those universities.

Sec. 2 (a) Para. (5)

No comment, since my experience is in industry, not in academia.

Sec. 2 (a) Para. (6)

I don't know whether this is true or not. Based on feedback from our recruiters, the numbers of women in the technical engineering fields seems to be reasonably represented. Such is not the case regarding minorities however, if we refer specifically to black minorities.

Sec. 2 (a) Para. (7)

I believe that the nation does face overall potential shortages.

To what extend that may be due to reduced Federal funds or to what extend Federal funds can or will be able to reduce that shortage, is a matter of debate.

All the Federal funds in the world will be of little or no value if the individuals entering the professions don't perceive a rewarding career as an end result.

I think that the "average" entering student does perceive a rewarding career in technical and engineering more so today than was the case 20 or so years ago.

Sec. 2 (a) Para. (8)

I can't comment as to adequacy or inadequacy of current programs.

Sec. 3 (a)

An undeniable, laudable, necessary statement of policy (an apple pie-and-motherhood statement, but necessary as preamble).

Sec. 3 a (1)

I suspect (but am not sure) that the existing Engineering Societies (ASME, ASCE, IEEE, etc.) and the Engineering Society Coordinating Council already does a reasonably good job at being the focal point for identification of engineering human resource needs, and I hesitate at wondering to what extend a Federal Agency will make use of already-existing information as opposed to being a redundancy. It would be presumed that maximum use of existing university/industry/Engineering Society information and knowledge would be made.

Sec. 3 a (2)

A broad statement which causes one to reserve judgment until more specific ways and means are defined.

Sec. 3 a (3)

Again, a broad statement that requires reservation of judgment.

Sec. 3 b
&
Sec. 3 b Para. (1)

A somewhat broad statement, but one that causes a considerable reservation of judgment out of concerns that blank checks may be handed out to Federal Agencies with doubts that the funds would be efficiently spent (or what?).

Sec. 3 b (2)

The natural skeptism of the ordinary taxpayer causes a withholding of judgment.

Sec. 4 (a)

No comment, except to what extend does the establishment of a Coordinating Council on Manpower within the NSF duplicate any existing responsibilities and functions of the NSF? I am not in a position to know one way or another, except that it was my understanding that one of the functions of the NSF is

> "---develop and help implement science education programs that can better prepare the nation for meeting the challenges of the decades ahead."

Is it possible that heretofore the NSF directed its efforts more towards the pure science and pure research activities and not towards the Engineering and Technical Applications activities? If so, then perhaps the establishment of a more specific Council within NSF is warranted. I don't know.

Sec. 4 (b)

No comment at this time.

Sec. 4 (c)

No comment.

Sec. 4 (d)

No comment.

Sec. 5 (a) (1)

A broad statement requiring reservation of judgment.

Sec. 5 (a) (2)

A very broad statement, no comment at this time.

Sec. 5 (a) (3)

A broad statement, a laudable aim.

Sec. 5 (a) (4)

An obvious result of the efforts of the Council.

Sec. 5 (a) (5)

This one is really an open-end statement. This effort could be as expansive or as narrow as funding would permit. (A lot of money could be spent on monitoring and assessing leaving nothing for implementation.

One has to presume, however, that there would be a reasonable balance.

Sec. 5 (a) (6)

A laudable aim, a somewhat apple-pie-and-motherhood statement. No final judgment could be made unless greater detail as to the envisioned ways and means of performing this function were defined.

I am a considerable skeptic as to the value of spending money on just "PR" work if that "PR" work is in the form of innocuous, generic commercials or advertisements.

A greater value occurs when high school students get an opportunity to come in and visit and talk to real-life engineers, etc. as had been the case at one time when a local Explorer Scouts group sponsored such a visit and communications between industry and potential engineers or technical people.

Sec. 5 (a) (7)

A laudable goal. Again, however, the lack of definition as to specific ways and means of accomplishing this causes reservation of judgment.

Sec. 5 (a) (8)

A broad statement, no comment.

Sec. 5 (b) (1)

Reserve judgment.

Sec. 5 (b) (2)

Reserve judgment, but already there would appear to be the origins of what could become uncontrolled bureaucracy instead of the accomplishment of the goals of the program.

Sec. 5 (b) (3)

Reserve judgment.

Sec. 5 (b) (4)

Reserve judgment.

Sec. 5 (b) (5)

Reserve judgment.

Sec. 5 (b) (6)

I certainly would hope that useful information is published.

Sec. 5 (b) (7)

No comment, a broad but necessary statement.

Sec. 5 (b) (8)

Reserve judgment. This is a very open statement.

Sec. 5 (b) (9)

A laudable aim.

Sec. 6 (a)

If one accepts the basic premise and desirability of the establishment of such a Council as this Bill proposes (and I do support that aim), then of course one has to establish funding, obviously.

Sec. 6 (b)

No comment, except that attempts to match supply and demand cannot be in the form of current supply/demand, but predicted future supply/demand because of the time lag between educational programs and when the results are usable.

The past and present, however, are the most usual indicators of the future.

Sec. 6 (c)

This leaves me wondering who reviews and approves grants that are less than $500,000 and $200,000, and what safeguards of responsibility would be established to prevent someone other thar the Council to approve multiple grants, each of which individually are less than $500,000 and $200,000, but which collectively are larger?

Sec. 6 (d)

The best feature of any funding program is the "matching funds" feature. This feature, more than any other single one inherently acts to place reasonable restraints on the judgments of people before they enter into a decision to spend money.

Sec. 6 (e)

No comment.

Sec. 6 (f)

No comment, but why not annually?

Sec. 7 (a)

I don't know what these rates are, therefore no comment.

Sec. 7 (b)

No comment.

Sec. 8 (a)

No comment; don't know whether $1,000,000 is too much or not enough.

Sec. 8 (b)

No comment; don't know whether $50,000,000 is too much or not enough.

EMPLOYMENT

Technical jobs here go begging despite employment crunc

By Alex Finkelstein

Despite a predicted higher unemployment rate in the new quarter for Pittsburgh (7.[illegible] percent in October), the state (9 percent in November) and the nation (8.4 percent in November), jobs in at least two high-paying specialized employment categories locally remain unfilled -- data processing and engineering.

A random review of computer programming analyst positions in Pittsburgh in various recent help wanted newspaper classified columns showed 119 openings in the $18,000 to $40,000 salary range, with the average pay at $27,000.

Ninety-seven engineering jobs in a variety of specialized areas were available for from $20,000 to $50,000, with the average salary at $34,000.

Machinists, as always, were in demand, but these positions were not as widely advertised in the newspapers as those for engineers and programmer analysts.

Computer programmers are "a highly mobile group," explained Robert Karulf, branch manager for western Pennsylvania of Source EDP, a 20-year-old Pittsburgh-based computer employment search firm. "The demand for their skills is continually growing and they can adapt to almost any environment."

This highly-skilled category seldom suffers a layoff and when it does, programmers "simply pack their bags and head next door," Karulf said. "There are more (high-paying) jobs in this sector than there are individuals to fill them."

He sees "no downturn for 1982" and expects demand for this specialized employment group to continue throughout the 1980s.

"What we are even beginning to see in some instances," Karulf said, "is a situation where some major Pittsburgh employers, in immediate need of experienced hands, are willing to over-compensate for the seasoned professional rather than begin with the entry level applicant."

Karulf said his firm could place "at least 100 experienced programmers tomorrow" if the supply were available.

Equitable Gas Co. is trying to fill a $19,000 computer programmer position. So is Westinghouse Credit Corp., Bacharach Instruments, Computer Sciences Corp., Alanthus Data Communications Corp., and Pennsylvania Engineering Corp.

Computerpeople, a Pittsburgh search firm, has 21 immediate openings, with starting pay ranging from $18,000 to $40,000. "Surely somebody in town wants these jobs," a Computerpeople spokesperson said.

Specialized engineering categories also remain a challenge for Pittsburgh area companies and employment agencies. Electrical instrumentation engineers and designers is an example. The pay may be anywhere up to $50,000 to start, depending on an applicant's credentials.

Rice: Needs chief process engineer

"That group specifically," notes Netha Hillard, employment manager at Swindell Rust, one of the world's leading designers and builders of heavy industrial plants, "is my biggest headache." Experienced hands are almost non-existent and en
level candidates seldom have the ba
ground or expertise for the deta
computer designing required on m
projects.

"Texas lures all the good ones aw
Hillard said. "They have the corner
this employment market for the ti
being."

Duquesne Light Co. is looking
engineers with a nuclear backgrou
for its Beaver Valley Power statio
Even without such expertise, Duques
is offering entry level positions w
starting pay at $24,000 for recent gra
uates with a bachelor of science deg
in either electrical, mechanical, met
lurgical or nuclear engineering.

"The competition for these skills
keen," a Duquesne spokesman sa
"and we expect it to continue for a lo
while yet."

Pennsylvania Engineering Corp.,
specialist in the design, engineering a
construction of steelmaking facilities,
offering $30,000 to $40,000 to start f
engineers knowledgeable in structura
foundations, mechanical, piping, ele
trical, planning and layout, and instr
mentation disciplines.

Vector Engineering, Inc., which r
cently moved to expanded quarters
the Standard Life Building downtow
has immediate openings for structur
engineers with steel and concrete expe

e. Salary scale is from $30,000 to 000. Structural and electrical drafts-ons are also needed with starting in the $18,000 to $[illegible] range.

nd even though Brown Boveri Con- Systems, Inc., is willing to pay a ting salary of between $25,000 and 000 for software engineers, Robert raji, the firm's personnel director, he may have to go outside Penn-nia for the required talent.

Ve would like to hire from Pitts-h, of course," Kraji said. "We are ing to see if these skills are available ."

reen International, Inc. headquar- l in Sewickley with offices in Boston, Lake City, Manila and Bogota, s a bridge engineer with a minimum years experience. Salary is open. en we find the right person, we'll ss salary," said Francine L. Snyder, onnel director. "That factor is not y to be a problem; finding the right on is."

ck L. Rice, Jr., manager of special oyment at Dravo Corp. is offering mpetitive salary" and "an excellent e benefit package" for a chief pro- engineer at Neville Island. "That cular type of engineer might be a difficult to find locally," he said.

neider Power Corp., a wholly- d subsidiary of Schneider, Inc., alizing in the power generation try, has immediate openings at its er Valley nuclear site for field engi-, planning and scheduling engi- piping designers and drafters.

neider, Inc., the parent firm, a in the mechanical construction try, needs piping drafters imme- y to complete its project in Craig, ade.

The Pittsburgh office of the state Department of Labor an Industry does not break out the number of positions immediately available in specific work categories, but besides engineers and computer personnel, the one category continually in demand is machinist.

"It seems we never have enough skilled machinists here," said Michael Dorosh, acting Pittsburgh regional director of the Pennsylvania State Job Service.

Outside of the skilled employment market, Manpower, Inc., a worldwide search firm of temporary services with offices in Pittsburgh, reports only 3 percent of area employers plan to increase staffs in the first quarter of 1982. A year ago at this time, 11 percent said they were planning to hire additional workers.

In his telephone survey with approximately 300 Pittsburgh employers made prior to Dec. 1, Manpower's George Kontos found 86 percent of the firms plan no change in staff levels; 3 percent were unsure of their hiring plans; and 8 percent anticipated staff reductions.

In a similar survey a year ago, 15 percent of Pittsburgh firms interviewed expected staff reductions; 58 percent predicted no change in staff levels; and 16 percent were unsure of their hiring plans.

Despite a nationwide 6 percent decline in the production of consumer durable goods in November, Pittsburgh area manufacturers still predicted "a few local job opportunities" in the first part of the new year. However, reductions were expected by employers in the service and construction sectors, and by manufacturers of non-durable goods. In other employment areas, the Manpower study found the 1982 outlook in Pittsburgh "stable."

[illegible]
37%

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A CORDOVAN BUSINESS JOURNAL

Mr. **Walgren**. Thank you very much, Mr. Procyk.

Let me ask one very brief question, and that is whether or not we sense, in general, the panel as a whole, that we are losing people in the high schools and then don't really get a chance to become good engineers or good scientists?

Do you have any feel from within your profession about our success or failure on that level?

Mr. **Procyk**. I'll put my 2 cents' worth in.

I have a definite feel. I believe I know that, yes, sir, we lose people in high school but I believe it is more due to the economic situation of their own families.

Now, how do I know that? Because, along with these 1,500 or 2,000 engineers that we have, we have a large number of drafters, also, or individuals who went to the 2-year degreed schools, be it Penn State here or Community College, and those individuals, drafters or 2-year engineers, have the same basic intelligence as those that we have as 4-year graduates, and when you are just talking with them, why didn't you happen to go to a 4-year school? Well, because the family didn't have the money. Either there were four in a family and two of them went to the university or some such situation like that.

Those individuals I know that we are losing.

Mr. **Walgren**. Yes, sir.

Mr. **Moore**. I think I would add one comment to Alex's remarks, and that would be that I think traditionally in our public schools, primary and secondary, there has not been a good relationship between careers and education.

I think we would all grant that, that our teachers in the lower grades are generally ill-equipped to give good career information and counselling to their students.

I would also point out that our colleges and universities could not have accepted many more freshmen engineers this past year.

At a meeting in San Antonio recently, which Congressman Fuqua also attended, we were advised that about 25 percent of our engineering schools in 1981, had put ceilings on their freshmen admissions. Accordingly, there are conflicting factors operating.

We talk about shortages and yet we limit enrollments. What is in short supply, is it interested, qualified people or is it faculty, equipment or facilities that are in short supply? I think maybe the latter.

Mr. **Walgren**. Mr. Green?

Mr. **Green**. There are a couple of points on this. Alex referred to them and I referred to them in my testimony.

First, looking at my children's education—they go to the same school system that I did when I was a child here in the Pittsburgh area—they get a much better basic science training than I did. They are much more science-oriented than my classmates were when I was going to school. That is a result of Sputnik. That is a result of policies that Congress adopted and State school boards adopted with stimulation from the Federal Government. But it took many, many years to raise the level just a little bit at the grade school and high school levels, both in terms of curriculum and in terms of trained faculty.

It's still not good, but it's a big improvement from what it was 20 years ago.

Second, we are seeing more engineers in school today, which is a response to a number of economic factors in society and better information about career opportunities. For the last 6 or 7 years, there have been fewer opportunities for people in the humanities to get good jobs than for people in sciences and engineering. And we are finally going to see those people come out of the pipeline.

But, as Alex says, it takes 3 years before you begin to make a contribution.

Oftentimes, I would say, in general, it takes a good 10 to 15 years of practice before you have begun to make major, important contributions in your field. So, what we want to avoid is choking off the recent hard-won increases. We have gotten the pipeline started, but we must avoid choking it off, which is what the policies that we are talking about here today are designed to do. How one deals with that is not an easy question.

Mr. **Walgren**. Thank you very much, Mr. Green.

We have a time problem, I am afraid, and I apologize for it. We have four additional witnesses and I am sure that they have schedules too.

Mr. **Ertel**. After that I will be extremely brief. I was interested in the Westinghouse Educational Foundation that you described.

How much money does that distribute yearly? And, secondly, are there other major corporations that you know of that have a similar type foundation?

Mr. **Moore**. Our level of contributing in 1982 will be $2 million a year. We tried to increase over the last half dozen years our payout level faster than the rate of inflation. I might say that our corporation has been generous in transferring funds to the Foundation so we could do that.

The second question, in the city of Pittsburgh, for example, Alcoa, United States Steel, Dravo, all have corporate foundations that supported education to a very, very strong and enlightened degree. And throughout the country——

And throughout the country——

Mr. **Ertel**. Are you one of the largest?

Mr. **Moore**. Largest in terms of our yearly payout?

Mr. **Ertel**. Yes, sir. I'm not talking about foundations such as Rockefeller or Ford; I'm saying corporate.

Mr. **Moore**. Yes, sir; I think I would have to say, Congressman Ertel, that we are, although Exxon, and similar oil foundations, are larger than some of those supported by more traditional manufacturing industries.

Mr. **Ertel**. All I want to do is figure out if industry is ever going to be able to pick up what Government is walking away from.

Mr. **Moore**. Let me answer that. I think industry is doing right now a tremendous amount, far more than you would suspect, and to put this additional overload is going to be difficult.

Mr. **Ertel**. Well, that is what I'm thinking. You were already contributing in the past even though the Government was putting a tremendous amount of money in. Now you talk about $2 million going to major corporations in more enlightened times, then to say that you are going to pick up the slack, if you will, I just don't think it works, and that is what I was trying to get at.

I think you probably answered my question or did you?

Mr. **Moore**. Just one other thing I might say. I am talking about foundation funds. On the corporate side Dr. Berg referred to the Robotics Institute of Carnegie Mellon. So we are putting corporate funds in that kind of a joint venture over and above what I am referring to from the foundation.

Mr. **Ertel**. I understand that it's specialized.

One other question, you indicated that you had adequate numbers of engineers at the present time coming through here in Pittsburgh, and then somewhere we talked about a lot of those scientists and engineers in this country and specifically the fact that they are foreign educated, are any of your people foreign educated who are filling the slots when you say you have adequate people?

Mr. **Procyk**. Yes, sir, very definitely.

Mr. **Ertel**. So, in other words, we are not really educating people within our own country. We are having to go abroad to make the adequate level that you are talking about in a recession year?

Mr. **Procyk**. Very definitely. I hadn't thought about that particular point, but the combination of the engineers that were educated in foreign countries that we currently employ is substantial enough. It probably ranges in the 5 percent or so range.

Coupled with the basic foreign technology forms the basis for a lot of our processes. That is also part of it.

Mr. **Ertel**. Thank you very much.

I would like to ask a lot more questions. I know you are pressed on time and we have another panel.

I appreciate your testimony. It was very helpful.

Mr. **Walgren**. Mr. Shamansky?

Mr. **Shamansky**. Thank you, Mr. Chairman.

I'd just like to ask a much more mundane question on the operation of the companies that might illustrate what you are facing. The computers have revolutionized engineering design through computer age design and computer age machines.

Can your companies hire engineers who are adequately trained in the use of CAD/CAM and how can we be assured that people skilled in the use of CAD/CAM will be trained in adequate numbers?

Can we have a role to insure this?

Mr. **Green**. Well, because they are new systems, there is a great deal going on in the engineering colleges. I think George referred to a program that he is encouraging at the University of Pittsburgh.

Engineers with good engineering training have no problem adapting themselves to CAD/CAM. There is no role in my view for Federal support of that. Those pieces of equipment, those tools are expensive; but they have high rates of return. They are very powerful and getting more powerful all the time.

They have very good rates of return and so all the companies that I am familiar with are willing to provide on-the-job training, together with the manufacturers of the equipment, if the personnel need education to run those systems.

However, those systems are being produced out of basic university research and basic company research, and I will say that the Japanese are way ahead of us, for instance, in bridge design in terms of developing the technology. So, what we are talking about is while we have plenty of funds for the operation by the private sector, this is an area where the basic research probably needs support.

The recent changes in the tax law also have a very favorable impact on actually adopting and buying those systems and adopting them for use. The negative side of the picture, which I refer to in my written testimony, is that the CAD/CAM systems will wipe out a large number of sub-professional support jobs.

As Alex pointed out, over the years a lot of the positions in engineering have been filled by people who got a lot of their training through an apprenticeship program. They were subprofessionals. They were not university-trained. They may not have been as broad-based in their skills perhaps as a university person, but they were capable of being trained to operate as both engineers and paraprofessionals.

CAD/CAM eliminates that route to professional practice, and I think, therefore, that it is going to have in the long run, the effect of requiring—as all technology does—more people with more training to fill the positions that will be available.

It again argues in favor of that.

Mr. SHAMANSKY. Wouldn't that be true of robotics?

Mr. GREEN. Yes, sir; the same impact. It eliminates a lot of lower level positions and creates positions that require higher skill levels in order to make a meaningful contribution to production and operation. So I think again it emphasizes the fact that we have constantly got to be educating our people and the whole range of people to move into higher skilled positions, not just today but 30 years from now.

Mr. MOORE. Maybe I can just make one comment. I think there is no question that CAD/CAM has a tremendous impact on the whole process of design. While it used to take 10 engineers 1 week to design one model, now with one engineer with appropriate equipment can create many designs. And further, he can make many design changes and see the impact on the product before it ever gets into production.

Not enough of our universities are in the position to teach this approach, and the approach needs to be taught. We have not yet scratched the surface of what this is going to do in terms of impacting our technical capability.

Mr. SHAMANSKY. Is there a national strategy, too?

Mr. MOORE. Congressman, I think that all schools are burning to bring this into the curriculum. The lead schools, the CMU's and the Cornells and the Lehighs and the Ohio States have made significant strides, but of 300 engineering schools there are a great number in the middle group that haven't the necessary resources. If resources are not forthcoming, we may in the country be graduating two or three different levels of engineers; support types with B.S. degrees, historically and traditionally trained.

Then we are going to have those who are really going to make the contributions.

Mr. SHAMANSKY. Thank you.

Mr. WALGREN. Thank you, Mr. Shamansky.

Gentlemen, thank you very much for your contribution and your time. We appreciate it.

Mr. **Walgren**. The next and last panel consists of four people representing the college level, Pittsburgh Community, Diane Wakefield, associate professor of chemistry and director of women at Chatham College; Mary Kostalos, assistant professor of biology, Chatham College; J. Matthew Simon, chairman, department of natural sciences and technology, Point Park College; and Andrew Korim, director of development, Community College of Allegheny County.

If you will come forward, please.

Let's go forward in the order that we have on the list.

Ms. Wakefield is not here.

Let's start with Professor Kostalos.

[A biographical sketch of Dr. Kostalos follows:]

9. VITAE

CURRICULUM VITAE - Mary S. Kostalos

Mary S. Kostalos
7500 Kensington Street
Pittsburgh, Pennsylvania 15221

Date of Birth: April 4, 1944

Married

Business Address:
Department of Biology
Chatham College
Woodland Road
Pittsburgh, Pennsylvania 15232

Phone:

Home: (412) 731 3834
Work: (412) 441 8200 ext. 321

Education:

Ph.D. (Biology), 1971, University of Pittsburgh
Major Field: Aquatic Ecology
Thesis Title: A Study of the Detritus Pathway: The Role of Detritus and the Associated Microflora in the Nutrition of *Gammarus minus* Say (Amphipoda: *Gammaridae*)
B.S. (Biology), 1967, Chatham College, Pittsburgh, Pennsylvania

Additional Training:
Summer, 1977, Special course, Biological and Ecological Effects of Radiation, Oak Ridge Associated Universisites, Oak Ridge, Tennessee

Summer, 1980 Seminar on liquid scintillation counting. Getting the most from your Liquid Scintillation Counter, Packard Instrument Company

Academic Honors:

National Science Foundation Trainee, 1967-70
Phi Beta Kappa, 1967
B.S. with Honors
Special Award for High Honors, 1965

Experience:

September 1980 - Assistant Professor of Biology, Chatham College, major duties include teaching, advising & directing undergraduate research.

June 1979 - August 1980 Co-Director, National Science Foundation funded Women in Science Program to update the skills of women with degrees in science. Faculty Grants Co-Ordinator for federal agencies. Lecturer, Biology.

Experience:

June 1977 - June 1979	Assistant Director, Women in Science Program
September, 1973 September, 1979	Assistant Professor of Biology, Chatham College

Papers:

Kostalos, Mary, 1975, Ecology and Man. Chatham Alumnae Recorder. 44(2): 8-9.

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Societies:

American Institute of Biological Sciences
Ecological Society of America
East African Wildlife Society
Audubon Society of Western Pennsylvania
American Association for the Advancement of Science
Association for Women in Science

References: Available upon request.

STATEMENTS OF DR. MARY KOSTALOS, ASSISTANT PROFESSOR OF BIOLOGY, CHATHAM COLLEGE; DR. J. MATTHEW SIMON, CHAIRMAN, DEPARTMENT OF NATURAL SCIENCES AND TECHNOLOGY, POINT PARK COLLEGE; ANDREW KORIM, DIRECTOR OF DEVELOPMENT, COMMUNITY COLLEGE OF ALLEGHENY COUNTY

Dr. **Kostalos**. I would like to thank Congressman Walgren and other members of the committee for inviting us to participate in these hearings.

I am Dr. Mary Kostalos, director of the women in science program in applied biology at Chatham College, and today I would like to talk about our women in science programs.

Those were originally funded using grants from the National Science Foundation career facilitation program. We believe those programs have been invaluable in encouraging women with scientific and technical degrees to enter or re-enter careers in science and that those women are a valuable resource.

Women from our programs have been useful, productive employees in corporations and agencies throughout the Pittsburgh area.

In 1977, Chatham College received a women in science grant from the National Science Foundation, to develop and establish a tuition-free career facilitation project for 20 women as part of a national effort to encourage women to enter scientific careers.

Because a large number of highly qualified women applied, 23 women were accepted into Chatham's full-time 12-month program in "Industrial Chemistry with a Management Option." A second grant in 1979 enabled the college to continue and expand the program in 1979–1980.

The Chatham program was designed to update the participants' backgrounds in chemistry and provide a basic background in management, computer science, and technical writing. This was accomplished through course and laboratory work, workshops, and internships, which are full-time work experiences in industry.

We feel the management portion of the program is of great value in providing the participants with a greater understanding of the corporate world and preparing them for careers in technically-related areas of marketing, sales, et cetera. It has also helped the women assess their potential and interest in the management area, an area in which women are severely under-represented.

Vital to the success of the program is the support and cooperation of local industry and Government agencies. This has been particularly important in providing internships, lectures in the industrial chemistry course, placement of the women and many other activities. This cooperation has benefited the participants, Chatham College and the community.

Because of the success of the program in the past, Chatham has committed its resources to offering the "Industrial Chemistry with a Management Option" in September 1982, as an institutionalized program supported by tuition.

A $93,100 grant from the National Science Foundation in 1980 is supporting a new program in applied biology. This 9-month, tuition-free program is based on the successful format of the industrial chemistry program, but is designed to provide women with the updated skills and knowledge needed to successfully enter graduate programs in fields of advanced biology. The program will run concurrently with the chemistry and the two are marketed in the same brochure and publicity. This allows a comparison of the responses.

Initial response has been positive to the biology offering, with many inquiries even in the early stages of publicity. Based on past inquiries into the industrial chemistry program this option should also be in high demand. We have found, however, that the cost, $3,250, is a large deterring factor. Those women who want and need the program, although desiring to attend, cannot find the money because of family commitments and are not eligible for financial aid, except possibly a guaranteed student loan.

Continued support of these and similar programs is essential if we want to assure that more women will enter scientific careers. At a time when America faces strong competition in the areas of science and technology and growing needs for technically trained people, women with training in the sciences are a resource we cannot afford to waste.

Women who leave the work force for even brief periods may find that their training has become outdated due to the rapid advances that occur in scientific and technical areas. Therefore, review and updating programs are essential to enable these women to re-enter the work force as productive employees.

The participants in both programs were an intelligent, highly-motivated group of women. All but two women had previous work experience in a science-related career. Most had left employment to raise a family and not had worked for 8 years or more. The majority had degrees in chemistry, but some majored in other fields, such as biology, bacteriology, medical technology, microbiology, physics, ceramic engineering, chemical engineering, education, and psychology. All had substantial backgrounds in chemistry. Eleven held graduate degrees, and the rest had B.A. or B.S. degrees.

All but two of the participants were United States citizens, 8 belonged to ethnic minorities, 38 of the women were married, 36 with children. Of the 12 single women, 5 were heads of the household.

The women in the 1978 program ranged in age from 23 to 48; most were in their 30's, and had received their degrees from 6 to 15 years before entering the program. The women in the 1980 program were slightly older, ranging in age from 25 to 58; most were in their 40's, and had received their degrees over 15 years before entering the program.

A number of women had sought employment in technical fields without success prior to the program. At least one had been told that her degree, received 15 years ago, "was worthless."

Particpants in the 1978 tuition-free program relied on their own resources for financial support during participation. Five women worked at a variety of part-time positions while participating in the program, and one woman held down a full-time job while participating.

Financial aid was made available to participants in the 1980 program through the NSF grant. Thirteen women were given financial aid awards ranging from $25 to $250 per month. One women worked part-time for the college chemistry department, five other participants maintained part-time work during participation and one part-time participant held a full-time teaching positions during the program.

Follow-up questionnaires show that as of June 1981, 19 of the 23 participants in the first program have been employed in professional positions. Three women are currently attending graduate school. One women has completed a master's degree in industrial hygiene and is currently employed.

Participants in the 1980 program have also been successful in securing challenging career positions. Of the 19 women who completed the second program, 15 of these women are employed. Two women have been accepted into graduate school, in law and industrial hygiene.

A wide variety of companies are represented. Many of the major corporations in the Pittsburgh area. I don't think I really need to go into the specifics there.

Their salaries range from $18,000 to $25,000. These are positions for which the participants would not have been eligible for or would not have had the confidence to apply for without the skills and knowledge in this career facilitation project.

A rough estimate of the Federal income tax which these women will pay shows the return on this investment in education. Thirty-three women employed at an average salary of $21,200 will pay, in a conservative estimate, $120,000 a year in taxes. This estimate is based on 1979 tax tables using a filing status of married filing separately, with one exemption.

Thus, for an investment of $160,503, the total of the two grants, the Government has received $120,000 additional taxes yearly, and will pay for the program in less than 2 years.

Without National Science Foundation support, Chatham would not have been able to establish and implement these tuition-free programs. The second grant was vital to enable us to expand and institutionalize the industrial chemistry program and make it an ongoing program within the college. We are particularly pleased that the 1980 and 1981 grants included stipends for some participants.

Continued support for the program and similar programs is crucial if women are to have equal opportunity for careers in scientific areas. Future support for the participants to cover tuition and other expenses is critical if the program is to continue and be available to those who need it most.

There is strong evidence of a continuing need for the program. Interest in the current program is great. It appears that there is a market for this type of program in the Pittsburgh area. Employment in both chemistry and advanced biology is expected to remain strong at least through the mid-1980's.

Women are severely under-represented in both areas. Therefore, the employment outlook for participants in these programs is very good.

Thank you, Mr. Chairman.

[The prepared statement of Dr. Kostalos follows:]

INTRODUCTION

In 1977, Chatham College received a Women in Science grant from the National Science Foundation to develop and establish a tuition-free Career Facilitation project for twenty women, as part of a national effort to encourage women to enter scientific careers. Because a large number of highly qualified women applied, twenty-three women were accepted into Chatham's full-time, twelve-month program in "Industrial Chemistry with a Management Option." A second grant in 1979 enabled the College to continue and expand the program in 1979-1980.

The Chatham program was designed to update the participants backgrounds in chemistry and provide a basic background in management, computer science and technical writing. This was accomplished through course and laboratory work, workshops and internships, which are full-time work experiences in industry. We feel the management portion of the program is of great value in providing the participants with a greater understanding of the corporate world and preparing them for careers in technically-related areas of marketing, sales, etc. It has also helped the women assess their potential and interest in the management area, an area in which women are severely under-represented. Vital to the success of the program is the support and co-operation of local industry and government agencies. This has been particularly important in providing internships, lectures in the industrial chemistry course, placement of the women and many other activities. This co-operation has benefited the participants, Chatham College and the community.

Because of the success of the program in the past, Chatham has committed its resources to offering the "Industrial Chemistry with a Management Option" in September 1982 as an institutionalized program supported by tuition.

A $93,100 grant from the National Science Foundation in 1980 is supporting a new program in "Applied Biology." This nine-month, tuition-free program is based on the successful format of the Industrial Chemistry program but is designed to provide women with the updated skills and knowledge needed to successfully enter graduate programs in fields of advanced biology. The program will run concurrently with the chemistry and the two are marketed in the same brochure and publicity. This allows a comparison of the responses.

Initial response has been positive to the biology offering, with many inquiries even in the early stages of publicity. Based on past inquiries into the Industrial Chemistry program this option should also be in high demand. We have found, however, that the cost, $3250, is a large deterring factor. Those women who want and need the program, although desiring to attend, cannot find the money because of family committments and are not eligible for financial aid, except possibly a Guaranteed Student Loan.

Continued support of these and similar programs is essential if we want to assure that more women will enter scientific careers. At a time when America faces strong competition in the areas of science and technology and growing needs for technically trained people, women with training in the sciences are a resource we cannot afford to waste. Women who leave the workforce for even brief periods may find that their training has become outdated due to the rapid advances that occur in scientific and technical areas. Therefore, review and updating programs are essential to enable these women to re-enter the workforce as productive employees.

PROFILE OF THE PARTICIPANTS

The participants in both programs were an intelligent, highly motivated group of women. All but two women had previous work experience in a science-related career. Most had left employment to raise a family and had not worked for eight years or more. Most had degrees in chemistry (29), but some majored in other fields: biology (10), bacteriology (2), medical technology (2), microbiology, physics, ceramic engineering, chemical engineering, education and psychology. All had substantial backgrounds in chemistry. Eleven held graduate degrees (5 with M.S., 5 with M.A. and one Ph.D.) and the rest had B.A. or B.S. degrees.

All but two of the participants were U.S. citizens, eight belonged to ethnic minorities, thirty-eight of the women were married, thirty-six with children. Of the twelve single women, five were heads of the household.

The women in the 1978 program ranged in age from 23 to 48; most were in their 30's, and had received their degrees from 6 to 15 years before entering the program. The women in the 1980 program were slightly older, ranging in age from 25 to 58; most were in their 40's, and had received their degrees over 15 years before entering the program.

TABLE I

Distribution of Participants

According to Years Since Last Degree

Years since last degree	1978 Program	1980 Program
0 - 5	4	5
6 - 10	7	5
11 - 15	7	2
above 15	5	15

A number of the women had sought employment in technical fields without success prior to the program. At least one had been told that her degree, received 15 years ago, "was worthless."

Participants in the 1978 tuition-free program relied on their own resources for financial support during participation. Five women worked at a variety of part-time positions while participating in the program and one women held down a full-time job while participating. Two of those women worked for the college chemistry department at various times throughout the program. Financial aid was made available to participants in the 1980 program through the NSF grant. Thirteen women were given financial aid awards ranging from $25 to $250 per month. One woman worked part-time for the college chemistry department, five other participants maintained part-time work during participation and one part-time participant held a full-time teaching position during the program.

PARTICIPANT PLACEMENT

Follow-up questionnaires show that as of June 1981, nineteen of the twenty-three participants in the first program have been employed in professional positions. Three women are currently attending graduate school. One woman has completed a master's degree in industrial hygiene and is currently employed.

Participants in the 1980 program have also been successful in securing challenging career positions. Of the nineteen women who completed the second program, fifteen of these women are employed. Two women have been accepted into graduate school, in law and industrial hygiene.

Employers represented by these groups are:

- Union Carbide, Bushy Run research Center
- University of Pittsburgh
- U.S. Dept. of Labor, MSHA Toxic Materials Branch
- Ohio Valley General Hospital
- Chatham College
- Penn Medical Laboratory
- Westinghouse (R & D, and Nuclear Technology Division)
- Pennex Products, Quality Control Laboratory
- Gulf, Research and Development (6)
- Concord Academy
- Seton-LaSalle High School
- Mobay Chemical Corporation (3)
- Koppers Company
- Biodecision Laboratories
- PPG Industries
- Pittsburgh Energy Technology Center
- V.A. Hospital.

Position titles include:

- Scientist
- Chemist
- Senior Chemist
- Administrative Co-ordinator
- Laboratory Technician
- Librarian
- Science teacher
- Chemistry teacher
- Technical Sales
- Computer Systems Engineer
- Market Research Analyst
- Medical Technologist
- Industrial Hygienist
- Product Representative

Graduate Schools represented are:

- University of Pittsburgh, Graduate School of Public Health-Health Administration, Industrial Toxicology
- Penn State University, Ph.D. program in Clinical Psychology, minor in Psychophysiology
- Virginia Tech, Master's program in Chemical Engineering

Their salaries range from $18,000 to $25,000. These are positions for which the participants would not have been eligible for or would not have had the confidence to apply for without the skills and knowledge in this Career Facilitation Project.

A rough estimate of the federal income tax which these women will pay shows the return on this investment in education. Thirty-three women employed at an average salary of $21,200 will pay, in a conservative estimate, $120,000 a year in taxes. This estimate is based on 1979 tax tables using a filing status of married filing separately, with one exemption. Thus, for an investment of $160,503, the total of the two grants, the government has received $120,000 additional taxes yearly, and will pay for the program in less than two years.

NATIONAL SCIENCE FOUNDATION SUPPORT

Without National Science Foundation support, Chatham would not have been able to establish and implement these tuition-free programs. The second grant was vital to enable us to expand and institutionalize the Industrial Chemistry program and make it an ongoing program within the college. We are particularly pleased that the 1980 and 1981 grants included stipends for some participants. Continued support for the program and similar programs is crucial if women are to have equal opportunity for careers in scientific areas. Future support for the participants to cover tuition and other expenses is critical if the program is to continue and be available to those who need it most.

There is strong evidence of a continuing need for the program. Interest in the current program is great. It appears that there is a market for this type of program in the Pittsburgh area. Employment in both chemistry and advanced biology is expected to remain strong at least through the mid 1980's. Women are severely under-represented in both areas. Therefore, the employment outlook for participants in these programs is very good.

Mr. **Walgren.** Thank you very much.

That is an extremely good testimony. I always look for instances where those programs return more than they cost and you really showed good evidence on that.

Thank you very much.

The next witness is Dr. J. Matthew Simon, chairman, department of natural sciences and technology, Point Park College.

[A biographical sketch of Dr. Simon follows:]

RESUME

J. Matthew Simon

Personal

Date of Birth: July 14, 1941
Place of Birth: Reading, Pennsylvania
Marital Status: Married, Janet DiPasquale Simon, Ph.D.
Son, Jacob Matthew Simon
Address: 5500 Rippey Place, Pittsburgh, Pennsylvania 15206
Telephone: (412) 441-2132

Education

University of Pittsburgh, 1974-1975 (Department of Higher Education-Postdoctoral Courses in Institutional Evaluation and Financial Administration)

Massachusetts Institute of Technology, 1972 (Education Research Center-Summer Institute on Personalized Systems of Instruction)

University of Pittsburgh, 1963-1969, Ph.D. (Analytical Chemistry)

Albright College, 1959-1963, B.S. (Chemistry-Major/Mathematics-Minor)

Professional Experience

August 1973 to present
Chairman of the Department of Natural Sciences and Technology at Point Park College (Pittsburgh, Pennsylvania). This department includes the areas of Biology; Chemistry; Mathematics; Physics; Earth Science; Civil, Mechanical, Electrical and Mining Engineering Technology; Medical Technology and special programs (coordinated with other institutions) in Health Services and Respiratory Therapy. My duties include the general supervision and evaluation of departmental instruction, curriculum and program development, management of the department budget, the preparation of course schedules and the recruitment of departmental faculty and staff.

Over the years my committee assignments have included: Executive Council, Academic Council, Search Committee for the Academic Dean (chairman), Committee for Faculty Evaluation (chairman), Committee for Evaluation of the Academic Dean, Plant Utilization Committee, Committee on International Students, Instructional Resources and Equipment Task Force Committee, Scholarship and Financial Aid Committee, Community Relations Committee and Admissions Committee.

My present faculty status is that of Professor (tenured) at Point Park College and Adjunct Professor at Saint Francis General Hospital, School of Respiratory Therapy Technicians (Pittsburgh, Pennsylvania). I was recognized among the Outstanding Young Men of America for 1978.

January 1973 to August 1973
Director of Studies for the European Campus of Point Park College (Lugano, Switzerland). My duties included supervision of the academic program at the European campus, maintenance of academic regulations, instructional evaluation, preparation of the academic calendar, the recruitment of adjunct faculty in Europe and the implementation of decisions reached by the college administration in Pittsburgh.

September 1969 to January 1973
Assistant Professor of Chemistry at Point Park College. My duties included teaching lectures and laboratories in general chemistry, analytical chemistry, instrumental analysis, physical chemistry and inorganic chemistry.

Publications and Professional Activities

"Polarography and Medium Effects in Sulfolane", Ph.D. Dissertation, University of Pittsburgh (1969).

"Polarography in Sulfolane and References of Potentials in Sulfolane and Other Non-aqueous Solvents to the Water Scale", J. F. Coetzee, J. M. Simon and R. J. Bertozzi, Anal. Chem., 41, 766 (1969).

"Voltammetry in Methanol, Ethanol and Sulfolane as Solvents", J. F. Coetzee and J. M. Simon, Anal. Chem., 44, 1129 (1972).

"A Dual Purpose, Self Paced Chemistry Course", Presented to the National Conference of Personalized Instruction in Higher Education (Washington, D.C.; April 5-6, 1974).

Lab Briefs I: Concepts and Applications, J. M. Simon, Point Park College Publication (1975).

Lab Briefs II: Introduction to Qualitative and Quantitative Analysis, J. M. Simon, Point Park College Publication (1975).

I have been involved in a number of professionally related projects, seminars and workshops as a participant, discussion leader or consultant. These include: Southwestern Pennsylvania Higher Education Council/Pittsburgh Higher Education Council (SPHEC/PCHE) Consortium Professional Development Project, SPHEC Workshop on Credit Exchange and Articulation, Workshop on Management for Leadership in the Academic Department, Conference on Education for Hospital Administration, Advisory Committee-Saint Francis General Hospital, Consultant to the Mathematics Department at the Western Pennsylvania School for Blind Children-Curriculum Project (1975), Advisor to the Community College of Allegheny County-South Campus Science and Engineering Technology (SET) Program and member of the Curriculum Advisory Committee of the Community College of Allegheny County-Allegheny Campus.

References

These will be mailed on request.

STATEMENT OF DR. J. MATTHEW SIMON

Dr. SIMON. I wish to express my pleasure at having the opportunity to speak to this subcommittee. I am serving presently as chairman of the department of natural sciences and technology at Point Park College.

I should note that Point Park College is a relatively young 4-year liberal arts college in downtown Pittsburgh. While it has excellent programs in dance, theater, journalism, business, and computer science, it is interesting to note the second largest department at the school in terms of full-time equivalents has become the department of natural sciences and technology, with majors in civil, electrical, mechanical engineering technology, and studies in environmental resources, mining engineering technology, biology, chemistry, and mathematics.

My remarks today will be brief and are of a general nature.

I will begin by noting that a study which was designed to determine what an international panel of 135 distinguished scholars believe to be the most important considerations for educational planning for the remainder of the century, recently was concluded. The study, funded by the Lilly Endowment and published by the Phi Delta Kappa Education Foundation, indicated that despite many other differences of opinion, nearly all of the panelists agree that the energy deficit and environmental pollution will be dominant problems for the remainder of the century.

In fact, problems in energy, material resources and environmental quality generally are inter-related. One simple but very important illustration of this is that of the Nation's water resources.

In addition to obvious effects on the quality of life, adequate water resources will leave an impact on any attempts at reindustrialization and energy self-sufficiency. Such implications are discussed in the monograph, water quality management under conditions of scarcity, from which I quote the following statements:

> While water is the most abundant natural resource on earth its distribution is not uniform, and many areas are facing growing problems of severe water scarcity...the lack of water, rather than land, may become the principal constraint on efforts to expand world food output and keep the world peace.
>
> As world population increases, the demand for water for food production, industrial activities, and domestic purposes grows and leads to heavier withdrawals of the limited renewable freshwater resources. Simultaneously these very same human activities generate wastes which are discharged into the depleted water resources...

While problems related to the availability of usable water wax and wane from year to year and from location to location, nevertheless, in the long term they are growing more and more intense. One aspect of the problem is the fact that many older metropolitan areas will face serious shortages in the coming years because of aging and deteriorating water delivery systems. In some cases the problem will be further exacerbated by difficulties related to ground water contamination.

New York City, where estimates indicate that as much as 30 percent of the water that enters the city system is lost in water main breaks and chronic leaks, is illustrative of the problems that many cities are, or will be, facing. Also, adequate water supply is likely to be a limiting factor in many energy resource projects, such as shale oil development and synthetic fuels.

While the deterioration of water and sewer systems throughout the Nation is quite serious, it is only part of a larger problem. Highways, bridges, port facilities and mass transit systems also are reaching the ends of their useful lives. Just maintaining, let alone expanding, this infrastructure of the Nation will be formidable.

To give evidence of the scope of our technological and scientific concerns and to contrast with what I have just said, I would like to indicate another area of national interest; that is the new merger of biology and engineering and the potential development of whole new industries based on biotechnology in the next 5 to 20 years. Already, a large number of established companies, as well as several new corporations, are involved in this rapidly developing field.

While aspects of today's industrial biology are the result of new developments—for example, recombinant DNA—many other aspects are based on renewed interest and refinements of "rediscovered" processes. Many such biological processes are now attractive because new and improved techniques to manipulate and use them have been developed or improved over the years and because these processes offer solutions to new problems; for example, waste disposal, pollution control, and enhanced oil recovery as well as the manufacture of chemicals and pharmaceuticals.

I believe it is vitally necessary that the implications of this new technology be fully considered. Much of the fundamental work in this area has been largely the product of American academic research and scholarship. It would be ironic if the large-scale development of biotechnology were left to foreign competition. Japan, which already has a strong and modern fermentation industry, recently has placed the development of new industrially related biological processes and techniques on a list of national goals.

It certainly would be possible to expand this testimony to include other examples of significant national interest; for example, electronics and information technology. However, at the bottom of all such discussion is the same basic point, if we do not educate enough scientists, engineers, and engineering technologists, as well as people in other disciplines who have an adequate understanding of science and technology, our capabilities to deal with technological problems and to utilize technological and scientific advances in our own best interest will be seriously impaired.

Recent reports by the Defense Department, the National Science Foundation, the American Association of Engineering Societies and the American Society of Engineering Education all have noted the following conditions:

One, there are serious shortages of teachers in engineering and technological areas;

Two, too few students are pursuing graduate studies in these areas;

Three, most engineering teaching equipment is obsolete.

High industrial salaries discourage many graduates from entering graduate schools and academic careers. In fact, it has been observed that the high demand of industry for graduates is consuming the "seed" for engineering education of the future. Also, more engineering graduates are choosing areas such as business and law, rather than engineering for graduate study.

This situation is made worse by the fact that almost 40 percent of the new Ph. D.'s in engineering are foreign nationals who must return to their home countries after completion of their studies.

Perhaps it would be worthwhile to note that while we are experiencing a shortage of engineers in this country, Japan alone is graduating approximately 13,000 more engineers per year than is the United States.

I feel there is a clear need to provide a coherent national policy for engineering, technical, and scientific manpower. Also, I wish to underscore the need to increase our commitment to education at all levels. I am specifically concerned about the implications of the reduced budget for education, especially aid to college students.

Michael I. Sovern, in an excellent article in the New York Times of February 7, 1982, indicated that it is conceivable that by the end of this decade we may face the greatest shortage of scientists and scholars in our history.

In conclusion, I wish to call attention to two points that I feel are especially important. One is that full consideration should be given to the use of small colleges as a national resource and as a pool of considerable talent to be used in the serious planning, development and execution of technical and scientific projects.

Second, I feel that it is important that we be as efficient as possible in the utilization of all of our human resources. By this I mean that we must provide for the increased participation of women and minorities in all areas of technology and science.

I support H.R. 5254, the National Engineering and Science Manpower Act of 1982. I feel that establishment of a National Coordinating Council on Engineering and Scientific Manpower and the provision of a national policy for engineering, technical and scientific manpower, is of utmost importance to the Nation's economic, strategic, and security needs.

[The prepared statement of Dr. Simon follows:]

TESTIMONY ON

H.R. 5254

J. Matthew Simon, Ph.D.
Point Park College
Pittsburgh, PA 15222

A study, which was designed to determine what an international panel of 135 distinguished scholars believed to be the most important considerations for educational planning for the remainder of the century, recently was concluded. The study, funded by the Lilly Endowment and published by the Phi Delta Kappa Education Foundation, indicated that - despite many other differences of opinion - nearly all of the panelists agreed that the energy deficit and environmental pollution will be dominant problems for the remainder of the century.

In fact, problems in energy, material resources and environmental quality generally are interrelated. One simple - but very important - illustration of this is that of the Nation's water resources. In addition to obvious effects on the quality of life, adequate water resources will leave a impact on any attempts at reindustrialization and energy self-sufficiency. Such implications are discussed in the monograph, Water Quality Management Under Conditions of Scarcity, from which I quote the following statements:

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While problems related to the availability of usable water wax and wane from year to year and from location to location; nevertheless, in the long term they are growing more and more intense. One aspect of the problem is the fact that many older metropolitan areas will face serious shortages in the coming years because of aging and deteriorating water delivery systems. In some cases the problem will be further exacerbated by difficulties related to groundwater contamination. New York City, where estimates indicate that as much as 30 percent of the water that enters the city system is lost in water main breaks and chronic leaks, is illustrative of the problems that many cities are - or will be - facing. Also, adequate water supply is likely to be a limiting factor in many energy resource projects, such as shale oil development and synthetic fuels.

While the deterioration of water and sewer systems throughout the Nation is quite serious, it is only part of a larger problem. Highways, bridges, port facilities and mass transit systems also are reaching the ends of their useful lives. Just maintaining - let alone expanding - this infrastructure of the Nation will be formidable.

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I believe it is vitally necessary that the implications of this new technology be fully considered. Much of the fundamental work in this area has been largely the product of American academic research and scholarship. It would be ironic if the large scale development of biotechnology were left to foreign competition. Japan, which already has a strong and modern fermentation industry, recently has placed the development of new industrially related biological processes and techniques on a list of national goals.

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High industrial salaries discourage many graduates from entering graduate schools and academic careers. In fact, it has been observed that the high demand of industry for graduates is consuming the "seed" for engineering education of the future. Also, more engineering graduates are choosing areas such as business and law, rather than engineering for graduate study. This situation is made worse by the fact that almost 40 percent of the new Ph.D.'s in engineering are foreign nationals who must return to their home countries after completion of their studies.

Perhaps it would be worthwhile to note that while we are experiencing a shortage of engineers in this country, Japan alone is graduating approximately 13,000 more engineers per year than is the United States.

I feel there is a clear need to provide a coherent national policy for engineering, technical and scientific manpower. Also, I wish to underscore the need to increase our commitment to education at all levels. I am specifically concerned about the implications of the reduced budget for education - especially aid to college students. Michael I. Sovern, in an excellent article in the New York Times of February 7, 1982, indicated that it is conceivable that by the end of this decade we may face the greatest shortage of scientists and scholars in our history.

In conclusion, I wish to call attention to two points that I feel are especially important. One is that full consideration should be given to the use of small colleges as a national resource and as a pool of considerable talent to be used in the serious planning, development and execution of technical and scientific projects. Secondly, I feel that it is important that we be as efficient as possible in the utilization of all of our human resources. By this I mean that we must provide for the increased participation of women and minorities in all areas of technology and science.

I support H.R. 5254, the "National Engineering and Science Manpower Act of 1982". I feel that establishment of a national Coordinating Council on Engineering and Scientific Manpower and the provision of a national policy for engineering, technical and scientific manpower is of utmost importance to the Nation's economic, strategic and security needs.

Mr. **Walgren**. Thank you very much, Dr. Simon, for your support.

[A biographical sketch of Mr. Korim follows:]

RESUME

ANDREW S. KORIM

Dean, Grants Management and Development to Community College of Allegheny County, Pittsburgh, Pennsylvania.

Prior Employment

Provost, Community College Component, West Virginia State College, Institute, West Virginia.

Specialist for Postsecondary Education, The Center for Vocational Education, Ohio State University, Columbus, Ohio.

Director of Grants Management and Development, Community College of Allegheny County, Pittsburgh, Pennsylvania.

Specialist in Occupational Education, American Association of Community and Junior Colleges, Washington, D.C.

Dean of Occupational Education, City Colleges of Chicago, Chicago, Illinois.

Coordinator of Evening College, Butler County Community College, Butler, Pennsylvania,

Education

Pennsylvania State University, B.A. Economics - Arts and Letters, 1956

University of Michigan, M.A. Economics, 1957

Northwestern University, Work toward Ph.D., Economics, 1957-58

Academic Honors

Phi Beta Kappa

Pi Gamma Mu

Professional Linkages

Member, Board of Directors, American Association of Community and Junior Colleges.

Member, Board of Trustees, Aerospace Education Foundation.

Member, Editorial Board, Journal of Studies in Technical Careers, Carbondale, Illinois.

Past President and Past Secretary, Council for Occupational Education, an affiliate of the American Association of Community and Junior Colleges.

Selected Publications, Papers and Presentations

Korim, Andrew S., "Educational Priority for the 1980's: Building Better Linkages," Proceedings of 1979 Annual Conference, Texas Technical Society, Waco, Texas, Spring 1980

Campbell, Dale F., and Korim, Andrew S., Occupational Programs in Four-Year Colleges: Trends and Issues, AAHE-ERIC/Higher Education Research Report No. 5, American Association for Higher Education, Washington, D.C. 1979

Korim, Andrew S., "Education and Work in the Future", presented at Conference on The Future of Work and The Community College, sponsored by the American Association of Community and Junior Colleges and The College of The Mainland, Texas City, Texas, October 19, 1978.

Korim, Andrew S., "Priority: Comprehensive Legislation for Associate Degree Institutions", presented at Fourth Annual Seminar of Council for Occupational Education, Hastings, Nebraska, September 28, 1978.

Korim, Andrew S., "Century III: Implications for Community and Junior College Research," presented at Annual Meeting of North Central Region Interest Group for Community/Junior College Research, American Educational Research Association, Madison, Wisconsin, July 15, 1976.

Korim, Andrew S., "Environment and Energy Problems: The Role of Education", presented at Illinois Environmental/Energy Master Plan Convocation, Sagamon State University, Springfield, Illinois, May 5, 1975.

Mr. **Walgren**. Dean Korim.

STATEMENT OF ANDREW KORIM, DEAN, GRANTS MANAGEMENT AND DEVELOPMENT, COMMUNITY COLLEGE OF ALLEGHENY COUNTY

Mr. **Korim**. Congressman Walgren, we are pleased that you brought this committee here to Pittsburgh and we are pleased that you asked us to participate in this hearing.

Our remarks today will not deal directly with the impact of the budget cuts on the operations of the National Science Foundation. I should point out that the Community College of Allegheny County has not really participated in the NSF funding. We feel that we have many, many programs on the drawing board that NSF could help us finance. We would prefer today, however, to talk about H.R. 5254.

The theme of our testimony is that new high technology creates an increasing demand for technicians and that there is a definite role that community colleges have in providing the Nation with these technicians.

In terms of H.R. 5254, it is certainly a step in the right direction to develop a national policy for engineering, scientific, and technical manpower. Our Nation has long suffered from the lack of such a policy. We would not be in many of the economic difficulties we are in today if we had, over the years, had a coordinated policy that looked at all of the sources of funds that are available for manpower development and human resource development generally.

By creating a National Coordinating Council on Engineering and Scientific Manpower, we should now be able to have a coordinated effort. We should, for the first time, be able to integrate the various sources into a common plan. We would, however, suggest that you broaden the membership of this committee to include senior level representation from the Department of Commerce, the Department of Defense, the Department of Labor and other departments in the executive branch of the Federal Government that have manpower training components in the programs they administer.

We would also hope as you proceed to strengthen this legislation, that you bring into sharper focus the high technology technicians needed to insure national self-sufficiency in designated high technology fields. We do not feel that the bill currently puts adequate emphasis on the critical role of technicians in the science and engineering fields.

In terms of the involvement of the corporate community we urge that explicit tax incentives to the private sector be included in the legislation. We feel in this particular case that partnerships between corporations and local community colleges and other colleges are essential, and I would say today that most of the corporations are contributing funds to the larger universities and colleges, but in the case of community colleges, we at the Community College of Allegheny County have not received such direct assistance from corporations, even though we train a lot of technicians for them. This would probably be the case with many community colleges across the country. Therefore, we urge that explicit references or direction in the bill be given to tax incentives for corporations to participate in supporting technician training by local community colleges.

We would hope that the bill could clearly identify the importance of determining particular deficiencies in particular occupational categories, and that there be an explicit role recognized in the bill for community colleges in addressing these deficiencies.

We urge that a closer linkage be built between existing Federal programs, such as the national student financial aid program and the program being specified in this bill, the Nation could realize greater public benefit from such programs as the federal student financial aid program. In many, many cases, the federal student financial aid program has not contributed to the extent that it should to the production of the scientific, engineering and technical manpower needed by this Nation. The program is not prioritized in such a way as to give emphasis to the concerns that this committee is addressing today.

We would also observe that the $500 million annually, which is specified in the act is inadequate to do the job that needs to be done. We, here in this Greater Pittsburgh-Wheeling-Cleveland-Detroit industrial corridor, in view of the emphasis that is likely to be placed on high technology development in the decade ahead, could use all of the funds for high technology reindustralization training. We would, therefore, suggest that you give consideration to pooling and redirecting the resources of the total Federal involvement in human resource development under the various acts.

Under section 5. (a), we request that the following item be added as a responsibility of the Coordinating Council on Engineering and and Scientific Manpower: the President is to make recommendations to the improved utilization of Federal resources by elementary and secondary schools, community colleges and technical institutes, and colleges and universities, and other educational institutions in preparing scientific, engineering, and technical manpower to strengthen our national posture in the science, engineering, and high technology fields.

We believe the bill could be strengthened by developing a series of titles addressing education priorities:

We request that a title placing emphasis on improvements in science and mathematics education in elementary and secondary schools, be singled out as a basic foundation for the preparation of young people, both as good citizens and as future engineers, scientists and technicians. We would hope that this particular title would concentrate on improving scientific and technological literacy.

We request a second title, a title addressing technician training and upgrading of technical personnel needed to support scientists and to contribute to the reindustrialization that this Nation is embarking on. In this particular title we would hope that there would be provisions for upgrading community colleges faculties who constitute the basic resources of the community college in addressing the technician training needs. We suggest that there be provisions in this title to encourage college-industry personnel exchanges. We would further suggest that this particular title include hardware provisions that would allow community colleges to be given distinct and clear support under the act to upgrade the equipment used in their instructional programs.

We request that there be a clear and separate title that would concentrate on the long-range needs of our Nation for scientists and engineers. This seems to be the major thrust of the bill now and obviously, what we would hope is that a title would single out long-range needs and the role of universities and baccalaureate institutions. But we would hope that these other titles could be explicitly included in the bill in order to give special attention to those particular needs.

In principle, support H.R. 5254. We think it is a step in the right direction. We would hope that you would be able to hold similar hearings across the Nation and that you would invite other community colleges to participate in the hearings. Generally speaking, when it comes to science, engineering and technician training, community colleges somehow got left out of the picture and we would hope that you could correct that.

We thank you for asking us to be here today.

[The prepared statement of Mr. Korim follows:]

NEW HIGH TECHNOLOGY CREATES INCREASING DEMAND FOR TECHNICIANS

Testimony before the Committee on Science and Technology,
U. S. House of Representatives
by
Andrew S. Korim, Dean
Grants Management and Development
Community College of Allegheny County
Pittsburgh, Pennsylvania 15222
February 11, 1982

Mr. Chairman, we are pleased to have this opportunity to give testimony at this hearing.

First of all, we think that it is extremely appropriate to have the House Committee on Science and Technology in this great City of Pittsburgh and County of Allegheny. Because of the concentration of headquarters offices of such industrial giants as Westinghouse Electric, Rockwell International, PPG, Alcoa, and numerous other corporations, and because of the contributions these corporations and the people of Pittsburgh and Allegheny County and their work ethic have made in the development and application of scientific discoveries and technological advances, this community is a logical location for this Committee to hold these hearings. Just as the technological growth of the past has centered in this industrial complex, the Greater Pittsburgh economic area will no doubt play a pivotal role in the renewal of the American economy.

New Technology to Underlie Reindustrialization

Although our nation's economy is resting on a plateau, we anticipate that the United States is on the verge of a wholesale reindustrialization provided that American industrial leaders have the incentives to move ahead. The Economic Recovery Tax Act of 1981 has apparently given industry that incentive to invest in new plant and equipment, and that new plant and equipment is likely to be of a totally different configuration than anything the typical American worker has seen. Computer-controlled robots and other computerized machinery are replacing men and women on production floors. A recent article in U. S. News and World Report (Nov. 30, 1981) notes, "While the completely automated factory remains a dream of the future, parts of it are here today in the form of robots. In a growing number of companies these computer-controlled machines have taken over for humans in the hot, heavy, dirty, and dangerous jobs where long hours make people careless and inefficient." Currently, about 5,000 such robots are in use in the United States, the article reported.

Not only are robots capable of doing the heavy, dirty, and dangerous jobs, the capability to have vision and touch are being built into robots allowing them to be used in jobs requiring judgments in the production process and in the inspection of the quality of products.

This high technology integrates micro-electronics, lasers, hydraulics, pneumatics and computers, and many other technologies to provide the opportunity to American industries to turn productivity up and to put American products on the domestic market at prices and quality competitive with Japanese and European manufacturers.

Technicians: The Critical Shortage

The technology is obviously there. Robots and other high technology devices are being designed. Engineers and scientists are obviously ahead of broad-based industrial applications, but there is one question: Are we able as a nation to reindustrialize with this high technology without doing something about the people who install and service these complex machines? The technician is in our opinion the critical element that has been neglected. Scientists and engineers are able to design a factory with high technology, but without properly trained technicians to install and service the instruments and processes of high technology, the reindustrialization will not materialize.

For each engineer or scientist, it is generally recognized that several technicians are needed to complete the work team. The following ratios seem to apply:

Type of Work	Professionals with Doctorate, Master, and Bachelor Degrees	Technicians with Associate Degrees
Research and Design of High Technology Equipment	1	3-5
Manufacture of High Technology Products	1	6-10
Use of High Technology Products	1	8-12

Although a difference of opinion on the ratio of technician to scientist and professional engineer may exist, the point that cannot be disputed is that for each professional several technicians are needed; otherwise the scientist and the engineer are unable to carry out their work on a cost-effective basis.

National Defense: High Technology Weapons

"Defense Priority: High Technology Weapons" is the caption of a recent article in the Pittsburgh Press (Lance Gay, Scripps-Howard Staff Writer, Dec. 6, 1981). The article notes that advocates of a strong national defense establishment have embarked on a defense policy that aims to provide the Pentagon with an array of expensive and exotic new weapons--high technology weapons.

To operate and service the high technology weapons systems, the Armed Forces will require well-trained technicians, especially in the E-4, E-5, and E-6 grades. These technicians will need knowledge and skills in such areas as micro-electronics, computer science, laser technology, and nuclear technology. At no time in the past were technically competent enlisted personnel in such demand as is the case today and will be the case in the decade ahead.

Reserve NCO Training Corps Proposed

To meet this demand for technicians,the Council for Occupational Education, an affiliate of the American Association of Community and Junior College, has proposed legislation to create a variation of the long established Reserve Officer's Training Corps found at many colleges and universities. Under this legislation, the nation's community colleges would produce technically-competent and militarily-ready reserve non-commissioned officers in designated high technology military occupational specialities and mission related leadership skills. A graduate of the program would receive a non-commissioned officer rank in an appropriate branch of the Armed Forces at the same time an associate degree would be awarded. Just as baccelaureate degrees and commissioned officers are the outcome of the ROTC, the associate degree graduate with an NCO rank can strengthen the enlisted ranks of our Armed Forces and place our national defense readiness on a stronger basis.

Interdependence of Economic Renewal and National Defense

The revitalization of the American economy, increased industrial productivity, national self-sufficiency in strategic high technology fields, and a moderized high technology national defense establishment are inseparable goals. The high technology technician's role in applying the high technology developed through the research of scientists and engineers in the reindustrialization of the nation especially in such great industrial corridors as the Pittsburgh-Wheeling-Cleveland-Detroit corridor, and in defense preparedness cannot be carried out without the skills that come from occupationally-focused training. Many existing technicians must be up-graded and new technicians must be trained to put the fruits of the work of the scientist and the engineer into cost effective utilization in the industries of the nation and in our military units.

We want this distinguished Committee to know that the nation's community colleges have the cost-effective, flexible delivery capabilities to produce needed technicians with high technology competencies.

Unless we as a nation are able to maintain a technically competent workforce, we will not reverse the trend toward dependence on Japanese corporations and other foreign producers for consumer goods and for sophisticated high technology products. Neither our economy nor our national security will remain sound unless we reverse this trend.

Student Financial Aid and National Manpower Priorities

Increasingly, it is becoming apparent that the Federal student financial aid program in its present form has had little relationship to increasing the productivity of the workforce; yet should not this be a concern? We raise this question here because obviously the source of funds for retooling the American workforce for the high technology of the immediate future is a paramount issue. America's youth need some signals as they choose curriculums; yet national student financial aid is administered with no attention to the specific need for engineers, scientists, and technicians essential now and in the future to make the American economy competitive in this era of high technology and free international markets.

Perhaps the reason why Federal student financial aid and other Federal expeditures for education are being tagged for severe cuts is no doubt due to the fact that too many decision-makers and opinion-setters do not see a direct relationship between the investment in higher education, or the outcomes of the higher education system, and the kinds of persons needed by the economy to ensure a high level of productivity and by the Armed Forces to ensure readiness in critical military occupational specialties.

We ask this Committee to exert its influence in maintaining current levels of investment in education, but that a clearer relationship of the contribution of programs like the Federal student financial aid program and the production of scientific, engineering and technical manpower be established. In our opinion, it is appropriate for this Committee to draw attention to the need for the national investment being made through student financial aid programs to become better focused on the training of persons for occupations in science and engineering fields and the upgrading of technical personnel who work in our science and engineering based industries. It may be that applications for such Federal educational aid should be approved only if the educational goals of a student or the outcomes of an institution's educational program can clearly show the expected impact on critical manpower shortages.

We believe it is reasonable to expect the Federal investment to produce a flow of personnel with the skills and knowledge needed for the people of this nation to benefit from today's technological possibilities and to ensure that as a nation we have a strong economy and self-sufficiency in strategic scientific and technological areas in the decade ahead.

H.R. 5254, A Step in the Right Direction

From the preceeding it should be clear that we look upon HR 5254, which proposes a National Engineering and Science Manpower Act, as a step in the right direction.

Indeed, we need a national policy on engineering, scientific and technical manpower. Our nation has long suffered from the lack of such a policy. We would hope that a national manpower policy could evolve to address the problems we are facing in our economy and in our defense establishment.

By creating a National Coordinating Council on Engineering and Scientific Manpower, as the Bill proposes, we should have a vehicle by which to bring a more effective linkage among the various principals whether they may be producers or users of scientific, engineering and technical manpower. We would, however, suggest broadening the membership to include senior representation from the Department of Commerce, Department of Defense, Department of Labor and other departments of the Executive Branch of the Federal Government that have manpower training components in programs they administer.

Similarly, a provision should be included in this legislation to bring greater coordination among the various committees of the House of Representatives, and the Senate, especially those that are concerned with labor and education, economic development, national defense, international trade and ways and means, in view of the often competing character of the work of these committees and the fact that the outcomes of these different committees sometimes work at cross purposes when it comes to such matters as manpower development. It is unfortunate that after billions of dollars of Federal involvement in education, we find that our nation has serious deficiencies in critical areas such as the scientific and engineering occupations.

Obviously, based on our earlier points, we would strengthen the legislation proposed by H.R. 5254 by:

(1) bringing greater focus on high technology technicians needed to ensure national self-sufficiency in designated high technology fields.

(2) providing explicit tax incentives to private industrial interests to stimulate partnerships with local educational institutions to strengthen educational programs to produce the manpower needed for reindustrialization in such industrial centers as Pittsburgh.

(3) identifying more clearly the critical deficiency in technicians in the science and engineering base of the nation and the strategic role that community colleges (including technical college and technical institutes) have to play in correcting this condition.

(4) developing a closer linkage between existing Federal programs such as student financial aid programs and the preparation of personnel for occupations in science, engineering, and high technology fields.

In view of the magnitude of the manpower problems that we are experiencing in the American economy, shortages in critical occupations and surpluses in others, we question the adequacy of the fiscal approach specified in the Bill. Rather than seek only $50,000,000 annually to carry out the Act, in view of our current unhealthy fiscal situation. we would suggest pooling and/or redirecting the resources of the total Federal involvement in human resource development under various Acts to give prioritized focus on engineering, scientific and technical manpower required to put our nation on sounder economic footing. The community colleges in the Pittsburgh-Wheeling-Cleveland-Detroit industrial corridor alone could utilize $50,000,000 annually to properly address the technician training needs to redirect and revitalize the industrial resources in the respective communities.

Furthermore, it may be appropriate to develop within the Act titles specifying fiscal resources for designated manpower development priorities such as:

(1) A title placing emphasis on improvements in science and mathematics education in elementary and secondary schools especially to stimulate increased participation of minorities and women in these fields.

(2) a title addressing technician training and upgrading technical personnel needed to support scientists and engineers and to reindustrialize economic areas and communities undergoing drastic change in their industrial base and the related role of partnerships among industry, labor and community colleges.

(3) a title focusing on the long range needs of our nation for scientists and engineers and the role of colleges and universities in meeting these needs.

As we have noted, we believe H.R. 5254 is a step in the right direction. We congratulate the Committee on Science and Technology for conducting this investigation of the gaps in our science, engineering and technical manpower delivery system.

Mr. Chairman, this completes our testimony.

Mr. **Walgren**. Thank you very much. We certainly appreciate that testimony and I am glad that you, in particular, were able to come and give it.

Sometimes I think we do overlook the real resources in our communities. You get focused solely on the ultimate level of research, or something like that, and yet here you have examples of people that are in positions to deliver personnel that can be used well in the system and make real contributions, and I go back to the example of the tax contribution that applies also to the community college. That is a clear example showing that if we could just add that little increment that is cost effective in multiple terms—that it is not really the word—but it is really good to see more money coming back to the taxpayer in return for an investment that makes somebody's life much more rewarding.

At this point I don't really have any questions. I just want to express my appreciation for the support you gave the bill. We are so limited in our abilities. The fact is that the $50 million figure was really chosen because it might be doable. We were not very specific in its allocation really, because we face such a big problem, and to be specific would divide it up into so many little pieces that perhaps the support would not be there.

But I, for one, certainly appreciate that testimony and we will be going on elsewhere in the country and I think we will find similar support which should be helpful.

Let me recognize Mr. Ertel for questions.

Mr. **Ertel**. Thank you, Congressman Walgren. I certainly appreciate hearing all of your testimony. I did have some questions but I want to limit them. One is to the gentlelady from Chatham College and your comments on the program which NSF has funded in Chatham College.

You indicated in your presentation that the United States was receiving payback and profit in as much as the recipients were paying taxes. I guess that it is one way to look at it. It does help the national economy. But it seems to me that there is another thing that may be involved here. Somebody gets a benefit from your college, tuition free. They come out and they get a fairly good job paying a fairly good salary. I think those people have an obligation back to the institution, if possible.

Do you have any kind of program following up, setting up, specific scholarship money that would then increase, if you will, the number of people who could participate in that program by following those students and—I hate to use the word dun them, but it might be appropriate—asking them to contribute to the school to continue these, because eventually NSF will probably withdraw from that program and then you will be able to fund it yourself?

Dr. **Kostalos**. Yes sir, we do, as a matter of fact. We have special permission to set up essentially a scholarship fund to provide scholarship money for women taking the chemistry program starting in 1982. We also have a modest program and attempt to reach out to some of the corporations which are also benefitting from some of the employees they are getting from the program. So we are making an effort to seek other sources of funds, particularly scholarship funds.

Mr. **Ertel**. Has it been successful?

Dr. Kostalos. It's pretty early to tell. The fund raising effort is part of Chatham's annual alumnae fund which continues until the end of June. We have had some response but the letters just went out in January so we haven't had time for a tremendous response.

Mr. Ertel. Are the funds earmarked for only that program?

Dr. Kostalos. Yes sir. We have arranged that they contribute to the annual fund of Chatham College, but earmark the funds specifically for the women in the chemistry program.

Mr. Ertel. Very good. I commend you on that because I think it is something that should be done. It is one way to stretch the dollar a lot further and I commend you on doing that.

I also appreciate the other testimony. I know that you are pressed for time and most of you haven't had lunch, and I appreciate your testimony.

I yield back the balance of my time.

Mr. Walgren. Thank you.

Mr. Shamansky.

Mr. Shamansky. I would like to tell you how interested I was in the illustration that you gave. I remember one of my cousins attended Chatham College. When did the name change?

Dr. Kostalos. I think in 1957 or 1958.

Mr. Shamansky. I agree with your observation with respect to the technicians. We have some technical institutes which get a lot of people back, not people who have been just in the private life or careers, to go back, but they are more mature and, I think, much more serious, and it is a tremendous influence on the availability of well trained people in our community.

You can imagine my regret when I see the administration is going to cut severely money for vocational education. I find this all very contradictory.

Thank you very much for your testimony.

Mr. Ertel. Would the gentleman yield?

I would just like to indicate that my cousin went to Chatham College, I hate to tell you how many years ago, back before the name changed.

Mr. Shamansky. Is there anybody here whose cousin didn't go to Chatham College?

Mr. Walgren. Well, thank you very much for your contribution.

[Whereupon, at 1:45 p.m., the subcommittee was adjourned, subject to the call of the Chair.]

APPENDIX

La Roche College
9000 Babcock Boulevard
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(412) 367-9300

February 8, 1982

To Whom It May Concern:

I have been asked to comment on the anticipated effects of proposed federal budget cuts in funds for science education on the science programs at LaRoche College (LRC). All science programs are administered by the Division of Nursing, Health and Natural Sciences (NHNS) at LaRoche. At present, we provide traditional, i.e., four year programs in biology, chemistry, mathematics, medical technology, the natural sciences and pre-professional studies. We also offer two baccalaureate degrees for registered nurses, a Bachelor of Science in Nursing (B.S.N.) and a Bachelor of Science for nurse anesthetists. We also offer the liberal arts component of a Bachelor of Arts degree for radiography technologists. It is apparent that the major thrust of N.H.N.S. is in the health-realted fields and we expect to expand even more into these areas in the future, perhaps on the graduate level.

The most immediate impact we at LaRoche anticipate is the loss of financial aid to our students. As you may appreciate, science education is somewhat more expensive both in costs to the individual student and costs to the college. The typical science student must, of course, pay the tuition applicable to every LRC student and also laboratory fees, usually over $100 per year. Furthermore, the average cost of science texts is higher than texts for other disciplines and most science courses require the purchase of a laboratory manual. This means the cost of texts and manuals alone can exceed $50 per course. Cut backs in financial aid grants and greater restrictions on eligibility can only mean more students will not choose a science education. As funding becomes marginal, students will undoubtedly enter less costly programs. It is possible that a true liberal arts science education will, like the degree in medicine, become a choice only for the wealthy. At a time when LRC is actively developing plans to recruit minority students, we may find such students simply cannot afford to go to college.

Beyond the cost to the student is the cost to the college. At a small school such as LaRoche, the cost of maintaining the laboratory facilities essential to any science program is large compared to other areas, such as administration and management. If the number of science students drops significantly, i.e. 25% to 30%, the entire science program may be endangered. Certainly our ability to offer upper division science courses, such as physical chemistry, embryology or research will be affected. Another factor which will affect the level of quality is that we currently employ three laboratory assistants through the work-study program. These are positions awarded to some of our finest students and allow more extensive laboratory experiences for them. We have already been informed that federal cut-backs will cause a decline in such positions - this at a time when we hope to expand our program to four positions.

Another area which has been already curtailed and now perhaps will disapper is funding for summer programs for high school students. In the past, such programs have not only allowed advanced training for such students but also have been a useful recruiting tool. In an area such as Pittsburgh, with its numerous fine colleges, any reduction in our recruiting potential is serious. Similarly, funds for summer workshops for elementary, middle and high school teachers have also been reduced. The sum of such reductions can only serve to reduce the quantity and quality of science-oriented students at LRC and other schools.

The federally funded Title III program has made numerous contributions to LRC, especially N.H.N.S. During the past two summers, Title III workshops have been available for faculty concerned with developing basic skills, such as reading and writing, within "content" courses. Such courses avoid the stigma attached to remedial or developmental programs and permit more students to complete their education within four years. I am proud to say that our science faculty has been very active in the basic skill program, including two of our nursing faculty. We have successfully included skill development components in virtually every area of science from basic mathematics to organic chemistry to community nursing. Our N.H.N.S. faculty have participated in mini-workshops for all LRC faculty on our work in basic skill. Any reduction in Title III funding will adversely impact on this important work. Title III has also been active in minority programs at LRC. We are all quite concerned that our ability to recruit and retain minority students will suffer. Losses in Title III funding will hurt science education at almost every level; faculty training, skill development, recruiting and retention of students, especially minority students.

One of the areas which has been steadily reduced over the past few years is funding from the National Science Foundation (N.S.F.). Currently, N.S.F. funding for equipment is virtually nonexistent for small colleges. Whether by design or circumstance, only larger schools can compete successfully for comprehensive funding. N.S.F. grants, especially of the multi-year type, for faculty training are nearly impossible to obtain. We no longer seem to receive notices of such opportunities as internships or workshops for faculty. Without three or five year grants to develop a comprehensive, ongoing program, small schools are put at a disadvantage when compared to large institutions with their greater resources.

Reduction in federal funding will impact at all levels of science education at LRC. Dwindling resources will cause smaller enrollments, less faculty preparation and stagnant facilities. I wish to point out that the sciences are a key part of any undergraduate liberal arts program. While I state the obvious, the entire curriculum at a small college, with limited resources, will be affected by less federal funding. I can only urge that small, developing colleges such as LaRoche be given a chance to survive. Nowhere is survival more difficult than in the sciences. Science educators must acknowledge the higher cost of such programs and those concerned with science education must provide the funding needed to allow poor and minority students access to such an education.

Thank you.

Yours truly,

Mark O. Farrell

Mark O. Farrell, Ph.D.
Chairperson of Nursing, Health
and Natural Sciences